

**EXPERT REPORT
OF**

**ANDREA WULF
Historian and Author**

Kelsey Cascadia Rose Juliana; Xiuhtezcatl Tonatiuh M.,
through his Guardian Tamara Roske-Martinez; et al.,
Plaintiffs,

v.

The United States of America; Donald Trump,
in his official capacity as President of the United States; et al.,
Defendants.

IN THE UNITED STATES DISTRICT COURT
DISTRICT OF OREGON

(Case No.: 6:15-cv-01517-TC)

Prepared for Plaintiffs and Attorneys for Plaintiffs:

Julia A. Olson
JuliaAOlson@gmail.com
Wild Earth Advocates
1216 Lincoln Street
Eugene, OR 97401
Tel: (415) 786-4825

Philip L. Gregory
pgregory@gregorylawgroup.com
Gregory Law Group
1250 Godetia Drive
Redwood City, CA 94062
Tel: (650) 278-2957

TABLE OF CONTENTS

TABLE OF CONTENTS..... ii

INTRODUCTION 1

EXECUTIVE SUMMARY 3

EXPERT OPINION 4

 I. The Influence of Alexander von Humboldt on American Environmentalism 4

 II. The Founding Fathers and the Balance of Nature 8

 III. The Founding Fathers and Humboldt’s Ideas of Nature: James Madison’s 1818
 Environmental Speech 11

 IV. Humboldt’s Influence on American Writers and Thinkers 15

 A. Henry David Thoreau..... 17

 B. George Perkins Marsh 18

 C. John Muir 19

CONCLUSION..... 21

EXHIBIT A: CURRICULUM VITAE A1

EXHIBIT B: LIST OF PUBLICATIONS (LAST TEN YEARS).....B1

EXHIBIT C: REFERENCESC1

EXHIBIT D: ADDRESS TO THE AGRICULTURAL SOCIETY OF ALBEMARLE..... D1

INTRODUCTION

I, Andrea Wulf, have been retained by Plaintiffs in the above-captioned matter to provide expert testimony regarding how the balanced order of nature and humanity's connection with nature, including the climate system, is deeply embedded in the history and tradition of the United States of America, as reflected by the nation's founding fathers' attitudes towards nature and other leading thinkers of the early republic. Specifically, I have been asked to opine on whether there is any historical support for the notion that nature in balance, not denigrated by humans, is an essential part of American history. I conclude that there is.

I trained as a design historian at the Royal College of Art in London and have studied, written and lectured across the world on the founding fathers and their relationship to nature, as well as on the history of western people's evolved understanding of the science of nature and of the evolution of our deepening understanding of the natural world in our politics, art and literature. I am a three-time fellow of the International Center for Jefferson Studies at Monticello and the Eccles British Library Writer in Residence of 2013. I am a member of PEN American Center, an International Fellow of the Explorer's Club, a member of The Society of Woman Geographers, a Fellow of the Linnean Society and a Fellow of the Royal Geographical Society. My latest non-fiction book, *The Invention of Nature*, on which I rely for significant portions of this expert report, won the Royal Society Science Book Award 2016 and the Costa Biography Award 2015. It was also the winner of the Inaugural James Wright Award for Nature Writing 2016 (Kenyon Review in association with the Nature Conservancy), Notable Book of Sigurd F. Olson Nature Writing Award (SONWA), the LA Times Book Prize 2016, the Ness Award 2016 from the Royal Geographical Society and the Acqui Storia Award 2017 (Italy). It was a finalist of the Kirkus Book Prize 2015 and was shortlisted for the Andrew Carnegie Medals for Excellence in Fiction & Nonfiction 2016, the Cundill Prize for Historical Literature 2016 and the 2017 Smart Book Awards (Jagiellonian University & Euclid Foundation, Poland). It won the Bayerische Buchpreis 2016 in Germany where it was in the Top Ten bestseller list for almost a year. It was selected by *The New York Times*' '10 Best Books of 2015.' It will be published in 25 countries. I'm currently filming a TV documentary about Alexander von Humboldt in Europe, US and South America for ZDF (Germany) and the Smithsonian Channel (US).

Much of this report is based on my books and my 15-year career as a published author in the field of the history of nature, environmentalism and science. To render my opinions in this report, I have reviewed United States' history, original letters, speeches, diaries, as well as 18th and 19th century publications and conclude that America's climate, landscape, soil, water, forests, and plants played a crucial role in the creation of the nation and became steeped with political ideology but also with hope for the future. Over the course of my research of the past years, I have spent many months at the International Center for Jefferson Studies, researched at the Mount Vernon Library, spent time at Madison's Montpelier, John Adam's Old House in Quincy, the National Archives in Washington, D.C., the archives of the American Philosophical Society in Philadelphia, the British Library and the Linnean Library in London, as well as numerous other libraries housing important records from the first 100 years of the nation's founding.

The nation's founding fathers' attitudes towards and their connection with nature as well as the American landscape was integral to the creation of the United States of America. Many of the founding fathers were deeply connected with nature because they were farmers and gardeners. The first four presidents of the United States (Washington, Adams, Jefferson and Madison) all used in one way or another nature in their fight to establish the United States. They imbued plants and trees with patriotic sentiments and invested America's landscape with a strong feeling of nationhood. They used their gardens and farms as a canvas upon which they created patriotic meaning. They planted native plant species as a political statement and used metaphors drawn from the natural world in their political writing and speeches. In fact, the most potent image of the American Revolution was the 'Tree of Liberty.' All four used nature symbolically, economically and ideologically.

A singularly important person who gave the world today's understanding of nature and an early concept of the interconnections of our planet is the German explorer and scientist Alexander von Humboldt (1769–1859). Humboldt in turn influenced many American thinkers, writers and early environmentalists, including some of the founding fathers. Humboldt came up with the concept of nature as a web of life. He described Earth as a living organism where everything is connected—from the smallest insect to the most towering tree. Nature, he said, was 'animated by one breath—from pole to pole, one life is poured on rocks, plants animals, and even into the swelling breast of man.' Humboldt was a visionary who predicted man-made climate change as early as 1800. More than 150 years ago he wrote that the 'restless activity of large communities of men gradually despoil the face of the Earth.'

Humboldt visited the United States in 1804 with the declared purpose to meet Thomas Jefferson (then the 3rd President) and his Secretary of State, James Madison. He was welcomed by both, and Madison in particular took Humboldt's ideas of nature to heart. In 1818, a year after his retirement, Madison gave a speech that was published in many newspapers across the country and that put him at the vanguard of forest and soil conservation in America. He warned Americans about the devastating effects caused by deforestation and the ruthless exploitation of the soil. He spoke of the importance of the atmosphere in supporting the life and health of humans and animals and questioned how the delicate balance of gases could be disrupted. He advised that the future of the nation depended on a more careful treatment of nature. Madison spoke of the symmetry of nature and warned about the devastating consequences that would result from disturbing the balance of nature. Man had to return to nature, he said, what man took from nature.

In my expert opinion, the founding fathers' passion for the natural world is deeply woven into the fabric of America and very much aligned with their political thought and ideology. They didn't just create the United States in a political sense but also understood the importance of nature as the foundation of the nation.

This report contains my opinions, conclusions and the reasons therefore. The opinions expressed in this report are my own and are based on the data and facts available to me at the time of writing. All opinions expressed herein are to a reasonable degree of scientific certainty and historical accuracy, unless otherwise specifically stated. Should additional relevant or pertinent

information become available, I reserve the right to supplement the discussion and findings in this expert report in this action.

A statement of my qualifications is contained in **Exhibit A** to this expert report. A list of publications I authored within the last ten years is shown in **Exhibit B** to this report. My report contains citations to the primary documents that I have used or considered in forming my opinions, listed in **Exhibit C**. However, the voluminous resources and references informing my opinions are listed in the endnotes of my books, *Founding Gardeners* and *Invention of Nature*. Attached as **Exhibit D** is James Madison's 'Address to the Agricultural Society of Albemarle, 12 May 1818.'

In preparing my expert report and testifying at trial, I am deferring my expert witness fees charged to the Plaintiffs given the financial circumstances of these young Plaintiffs. If a party seeks discovery under Federal Rule 26(b), I will charge my reasonable fee of \$250 per hour for the time spent in addressing that party's discovery.

EXECUTIVE SUMMARY

We are shaped by the past. Nicolaus Copernicus showed us our place in the universe, Isaac Newton explained the laws of nature, Thomas Jefferson gave us some of our concepts of liberty and democracy, and Charles Darwin provided that all species descend from common ancestors. These ideas define our relationship to the world.

Alexander von Humboldt gave us our concept of nature itself, a concept reflected in the principles of liberty upon which the United States was built. Humboldt's interdisciplinary methods and his concept of nature as one of global patterns has had a profound effect on many leading thinkers in the United States, including some of the founders but also writers and poets who have shaped the American mind such as Henry David Thoreau and John Muir.

Humboldt wrote that earth was a living organism—an interconnected web of life that humankind could easily destroy. He prophetically identified that the human species could even change the climate through deforestation, changed hydrology and industrialization. He warned that humans were meddling with the environment and that this could have an unforeseeable impact on 'future generations.'

Humboldt wrote that the greatest lesson that nature offered was that of freedom. 'Nature is the domain of liberty,' Humboldt said, because nature's balance was created by diversity, which might in turn be taken as a blueprint for political and moral truth. The relationship between nature and liberty is echoed by the founding fathers in their writings and speeches as well.

The first four presidents regarded themselves first and foremost as gardeners and farmers, not as politicians. Washington gave up the presidency after two terms so that he could farm his fields. He said, 'Nothing in my opinion would contribute more to the welfare of these States, than the proper management of our Lands.' That sentiment was repeated again and again by the first four presidents. They believed that an agrarian republic of small farms was the way to 'national

happiness, dignity and independence.’ They were also naturalists and philosophers of nature and science, and wielded their views of nature and man’s connection to nature as a political tool and as integral to the founding of the republic. It was the Constitution that welded them together politically, legally and economically, but it was America’s nature, soil and plants that provided a transcendent feeling of nationhood. Nature was inextricably linked to guarding liberty.

Madison’s 1818 speech, just after retiring from his presidency, is emblematic of how deeply rooted the importance of nature in balance was to the founders and to the young nation. Madison was the first American politician to write that ‘the atmosphere is the breath of life. Deprived of it, they all equally perish,’ referencing animals, man and plants. He spoke of the balanced composition of the atmosphere and the give and take of animals and plants, which allowed the atmosphere the aptitude to function so as to support life and the health of beings, according to nature’s laws. The threat to nature in 1818 was largely from deforestation, the degradation of soils and the agricultural practices that Humboldt spoke of—threats to what Madison called the ‘symmetry of nature.’

In 1819, it was reported that there was no other country where heads of state would return to their private lives to promote agriculture, botany and other useful sciences that add ‘to the welfare of their country and of mankind in general.’ Only in America ‘we have witnessed, and still witness, such examples in the retired lives of Washington, Adams, Jefferson and Madison.’ That was the nature of the revolutionary generation.

The inspired teachings of humanity’s connection to nature by Humboldt are also reflected in the writings of Ralph Waldo Emerson, Henry David Thoreau, American Ambassador and ecologist George Perkins Marsh and John Muir. These American leading thinkers and nature writers were influenced by the same scientists and nature explorers who too inspired the revolutionary men of the United States of America—the men who themselves founded their very liberties literally and figuratively in the soils of a new nation, as farmers and gardeners.

The ‘breath of life’ that the atmosphere, forests, soils, waters (the climate system) was to the agrarian society in which the founding fathers lived was also foundational to the liberties they staked out for their new nation. There may be no other implicit liberty right more rooted in the history and traditions of the United States than the right to a climate that sustains life, the life that humans have enjoyed for generations and that is now catastrophically threatened.

EXPERT OPINION

I. The Influence of Alexander von Humboldt on American Environmentalism

Alexander von Humboldt (1769–1859) was a visionary thinker and the most celebrated scientist of his age. His contemporaries called him the most famous man after Napoleon and the ‘Shakespeare of the Sciences.’ He influenced many of the greatest thinkers, artists and scientists of his day. Thomas Jefferson called him ‘one of the greatest ornaments of the age.’ Charles Darwin wrote that ‘nothing ever stimulated my zeal so much as reading Humboldt’s *Personal Narrative*,’ saying that he would not have boarded the *Beagle* without Humboldt (and therefore

not conceived of the *Origin of Species*). British Romantic poets William Wordsworth and Samuel Taylor Coleridge both incorporated Humboldt's concept of nature into their poems. Goethe, Germany's greatest poet, declared that spending a few days with Humboldt was like 'having lived several years'. Even Captain Nemo in Jules Verne's famous *Twenty Leagues Under the Seas* is described as owning the complete works of Humboldt.

America's most revered nature writer, Henry David Thoreau, found in Humboldt's books an answer to his dilemma on how to be a poet *and* a naturalist—*Walden* would have been a very different book without Humboldt. John Muir's ideas on forest preservation were also heavily influenced by Humboldt's writings. In North America alone, four counties, thirteen towns, mountains, bays, lakes and a river are named after him, as well as the Humboldt Redwoods State Park in California and Humboldt Parks in Chicago and Buffalo. North America's newest mammal—the recently discovered Humboldt's flying squirrel—also carries his name. Even the state of Nevada was almost called Humboldt when the Constitutional Convention debated its name in the 1860s. Almost 300 plants and more than 100 animals are named after him, as are several minerals and on the moon there is an area called 'Mare Humboldtianum.' In fact there are more places, plants and animals named after Humboldt than anyone else.

Ecologists, environmentalists and nature writers rely on Humboldt's vision, although most do so unknowingly. Rachel Carson's *Silent Spring* is based on Humboldt's concept of interconnectedness, and scientist James Lovelock's famous Gaia theory of the earth as a living organism bears remarkable similarities. When Humboldt described the earth as 'a natural whole animated and moved by inward forces,' he pre-dated Lovelock's idea by more than 150 years. Humboldt called his book describing this new concept *Cosmos*, having initially considered (but then discarded) "Gäia" as a title.

Born in 1769 into an aristocratic Prussian family in Berlin, Humboldt left his life of privilege and spent his substantial inheritance on a dangerous five-year exploration of Latin America (1799–1804). He ventured deep into the mysterious rain forests in Venezuela and paddled along crocodile-infested tropical rivers. He walked thousands of miles through the Andes, from Bogotá (Colombia) to Lima (Peru)—climbing volcanoes along the way, including Chimborazo, then believed to be the highest mountain in the world. As he traveled through Latin America, Humboldt recognized nature's vulnerability and realized that humankind was destroying the environment.

As I explain in my book *The Invention of Nature*, Humboldt came up with the idea that nature was a web of life and described Earth as a living organism. Everything was part of this 'never-ending activity of the animated forces,' Humboldt wrote. His discussion of climate is just one example that reveals how different his approach was. Where other scientists focused only on meteorological data such as temperature and weather, Humboldt was the first to understand climate as a system of complex correlations between the atmosphere, oceans and landmasses. He wrote of the 'perpetual interrelationship' between air, winds, ocean currents, elevation and the density of plant cover on land. Nature was a 'living whole' where organisms were bound together in a 'net-like intricate fabric'. Nothing, not even the tiniest insect or fleck of moss, was looked at on its own. 'In this great chain of causes and effects,' Humboldt said, 'no single fact can be considered in isolation.' When nature is perceived as a web, its vulnerability also

becomes obvious. Everything hangs together. If one thread is pulled, the whole tapestry might unravel.

After Humboldt saw the disastrous environmental effects of colonial plantations—cash crops (monoculture), irrigation, and deforestation—in Venezuela in 1800, he became the first scientist to talk about harmful human-induced climate change. Deforestation made the land barren, he said, and with the disappearance of brushwood, torrential rains washed away the soils, while water levels of lakes were falling. The fields of the plantations looked exhausted and in a few years, he predicted, nothing would grow there anymore. The soil was being exploited ‘like a mine.’ Humboldt was the first to explain the fundamental functions of the forest as an ecosystem: the forest’s ability to enrich the atmosphere with moisture, its cooling effect as well as its importance for water retention and protection against erosion. He described how mining exploited the land and the indigenous people. Large-scale irrigation, he said, would turn parts of Venezuela into arid deserts and the valleys beneath the high plateau of Mexico City into desolate landscapes—seeing this, he declared ‘I think, they are raping nature.’

There were moments when he was so pessimistic that he painted a bleak future of voyages into space, when humans would spread their lethal mix of vice, ignorance and greed even across other planets—turning them ‘barren’ and leaving them ‘ravaged’ as they were already doing with Earth, Humboldt wrote in 1801, just three years before he met Jefferson and Madison. In 1844, he prophetically listed three ways in which the human species was even then affecting the climate: ‘Through the destructions of forests, through the distribution of water, and through the production of great masses of steam and gas at the industrial centres.’ He warned that humans were meddling with the environment and that this could have an unforeseeable impact on ‘future generations.’ It was all an ecological chain reaction. ‘Everything,’ Humboldt said, ‘is interaction and reciprocal.’

Nature was Humboldt’s teacher. And the greatest lesson that nature offered was that of freedom. ‘Nature is the domain of liberty,’ Humboldt said, because nature’s balance was created by diversity, which might in turn be taken as a blueprint for political and moral truth. Everything, from the most unassuming moss or insect to elephants or towering oak trees, had its role, and together they made the whole. Humankind was just one small part. Nature itself was a republic of freedom.

Humboldt wasn’t just a prescient proto-environmentalist whose work inspired the founding fathers, writers, scientists, and leading thinkers of the 18th and 19th centuries; he was a thinker who believed nature and imagination are inseparable. At a time when other scientists were searching for universal laws to understand nature, Humboldt insisted that ‘nature must be experienced through feeling.’ He said, ‘what speaks to the soul escapes our measurements.’ Humboldt wanted to excite a ‘love of nature.’ Nature, he explained, had to be described with scientific accuracy but without being ‘deprived thereby of the vivifying breath of imagination.’ Nature, he wrote, was in ‘mysterious communion’ with our inner feelings. A crisp blue sky, for example, triggers different emotions than a heavy blanket of dark clouds. Tropical scenery, densely filled with palm trees and sculptural orchids, has a different effect than an open forest of white-stemmed slender birches, he insisted. This celebration of awe, magnificence, wonder—whatever you name it—was part of his understanding of nature and part of what inspired the

other revolutionaries of his time. Humboldt wrote that the sensuous was connected with the intellectual, and he talked about a deep-seated bond that unites science, art, and poetry. It's this interdisciplinary approach, coupled with his insistence in the value of imagination and emotions in our understanding of nature that makes his work so relevant today.

Humboldt's vision of deep reverence for nature and human connection to it is reflected in American art, poetry, literature, music, and laws. Humboldt's philosophy, carried forward in part by early American leaders, is reflected in the subsequent addresses of many U.S. presidents. Lyndon B. Johnson's message to Congress in 1966 on 'Preserving Our Natural Heritage' is but one example of Humboldt's and the founding fathers' legacy carried forward by American Presidents. Johnson wrote:

‘A nation that offered its people a century ago uncharted forests, broad sparkling rivers, and prairies ripe for planting, may have expected that bounty to endure forever. But we do not live alone with wishful expectations. We live with history. It tells us of a hundred proud civilizations that have decayed through careless neglect of the nature that fed them.’

He warned, as Madison did before him, ‘We see that we can corrupt and destroy our lands, our rivers, our forests, and the atmosphere itself all in the name of progress and necessity. Such a course leads to a barren America, bereft of its beauty, and shorn of its sustenance.’ He pleaded, ‘Let us from this moment begin our work in earnest so that future generations of Americans will look back and say: ‘1966 was the year of the new conservation, when farsighted men took farsighted steps to preserve the beauty that is the heritage of our Republic.’

There are many other examples from previous and subsequent Presidents of the United States, from Theodore Roosevelt's White House Conference on the Conservation of Natural Resources in May 1908 which defined conservation as a decidedly political issue to Barack Obama's Proclamation in May 2015 in which he declared ‘we reaffirm our vital role as stewards of our planet.’

On December 8, 1908, Theodore Roosevelt gave his Eighth Annual Message to Congress in which he recognized the nation's need to conserve its natural resources particularly for children and future generations, but also underlined the responsibility of present generations for the future of the next generations:

If there is any one duty which more than another we owe it to our children and our children's children to perform at once, it is to save the forests of this country, for they constitute the first and most important element in the conservation of the natural resources of the country. . . . Any really civilized nation will so use all of these three great national assets [the soil, the rivers, and the forests] that the nation will have their benefit in the future. Just as a farmer, after all his life making his living from his farm, will, if he is an expert farmer, leave it as an asset of increased value to his son, so we should leave our national domain to our children, increased in value and not worn out.

The following year, on January 22, 1909 Theodore Roosevelt addressed Congress about a National Conservation Commission Report that contained ‘the first inventory of its natural resources ever made by any nation.’ After recognizing the unprecedented growth of the nation and demands upon the natural resources ‘for their livelihood, comfort and convenience,’ Roosevelt advised that ‘it is high time to realize that our responsibility to the coming millions is like that of parents to their children, and that in wasting our resources, we are wronging our descendants.’ Roosevelt declared:

The function of our Government is to insure to all its citizens, now and hereafter, their rights to life, liberty and the pursuit of happiness. If we of this generation destroy the resources from which our children would otherwise derive their livelihood, we reduce the capacity of our land to support a population, and so either degrade the standard of living or deprive the coming generations of their right to life on this continent. If we allow great industrial organizations to exercise unregulated control of the means of production and the necessities of life, we deprive the Americans of today and of the future of industrial liberty, a right no less precious and vital than political freedom. Industrial liberty was a fruit of political liberty, and in turn has become one of its chief supports, and exactly as we stand for political democracy so we must stand for industrial democracy.

The rights to life and liberty are fundamental, and like other fundamental necessities, when once acquired, they are little dwelt upon. The right to the pursuit of happiness is the right whose presence or absence is most likely to be felt in daily life.

II. The Founding Fathers and the Balance of Nature

After exploring South America for five years, Humboldt sailed to North America to meet Thomas Jefferson, the third President of the United States and to witness a society built as a republic and on the principles of liberty. From a young age Humboldt had been surrounded by Enlightenment thinkers who had planted the seeds of his life-long belief in liberty, equality, tolerance and the importance of education. He wrote to Jefferson upon his landing in the U.S. that he wanted to meet the people who had forged a republic in America and ‘who understood the precious gift of liberty.’ Humboldt arrived in Washington, D.C. in June 1804, buzzing with his concept of nature but also with the memories of huge deforested swathes of land, barren mountain slopes and depleted fields—and his ideas fell on fertile grounds because the founders had created a country founded on their beliefs about the importance of nature.

Jefferson and Madison (as well as Washington and Adams) regarded themselves foremost as gardeners and farmers, not as politicians. ‘I am entirely a farmer, soul and body,’ Jefferson declared, and ‘no occupation is so delightful to me as the culture of the earth.’ During his time as the president, Jefferson would ride out every day into the surrounding countryside of Washington, D.C., to escape from the tedium of governmental correspondence and meetings. The third president of the United States preferred to wade through swamps and climb rocks, and to pick up a leaf or a seed, rather than attend cabinet meetings. No plant, a friend said—‘from the lowliest weed to the loftiest tree’—escaped his scrutiny. In his private study in the White House,

Jefferson kept a set of garden tools to prune and tend his potted roses and geraniums. He had done the same when he was the secretary of state and lived in New York, where he was growing twenty-three precious plants of upland rice in pots on the windowsills. Jefferson's love for botany and gardening was so well known that American diplomats sent seeds to the White House from all over the world.

Jefferson was also an avid naturalist obsessed with taking measurements and recording species. For much of his life he kept a daily temperature and climate log (and convinced James Madison to do the same). He was a real polymath and with him as president, the White House had become the nexus of science, a control room of scientific inquiry. At dinner, botany, geography, meteorology and explorations joined farming and agriculture as the favorite topics of conversation. The range of Jefferson's interest was huge—from lunar observations to the close examination of worms that attacked Lombardy poplars. At some stage Jefferson used the East Room, which has subsequently been used for lavish state dinners, for something he thought much more important: the storage of fossils. Where today foreign dignitaries sip cocktails on the lawn, Jefferson briefly kept two living grizzly bears that arrived from the West. Jefferson was so obsessed with nature that he (together with John Adams) had gone on a garden tour through England in 1786 when their trade negotiations with the British stalled.

Earlier, during the War of Independence, George Washington had famously dreamed of an agrarian society where 'our Swords and Spears have given place to the plough share and pruning hook.' When Washington had decided to retire after the second term of his presidency in order to return to farming and gardening, he knew that he would leave an enduring stamp on American politics. For the irony is that what we interpret as a necessary check on, and curtailment of, executive power—the two-term presidency that would become a cornerstone of America's democracy—had its seed in the president's refusal to brook any further delay in his return to his fields and forests at Mount Vernon. So many had expected Washington to be president for life but he refused power so that he could till his fields. 'Nothing in my opinion,' Washington said, 'would contribute more to the welfare of these States, than the proper management of our Lands.' That sentiment was repeated again and again by the first four presidents.

All four—Washington, Adams, Jefferson and Madison—agreed that agriculture should be the foundation of America. Madison was known as a man who believed that agriculture was 'the surest basis of our national happiness, dignity and independence.' And they all saw themselves as model farmers and were experimenting with crop rotation and manure to improve the depleted soil. Jefferson famously designed the mould board of a plough, Washington invented a sixteen-sided treading barn, Adams investigated the piles of manure that he encountered during his travels and Madison wrote hundreds of letters about his fields, ploughs and forests. Jefferson tested new vegetables, crops and fruits at Monticello, using his fields and garden as an experimental laboratory. He believed that the 'greatest service which can be rendered any country, is to add an useful plant to its culture.' In Monticello, he grew 330 varieties of 99 species of vegetables and herbs. Jefferson never expected that all varieties would do well. He wanted to find the best, not the most. If only 'one species in a hundred is found useful and succeeds,' he said, it was worth the trial. 'One service of this kind rendered to a nation,' Jefferson said, 'is worth more to them than all the victories of the most splendid pages of their history.'

As long as a man had his own piece of land, Jefferson believed, he was independent. He had even argued that only farmers should be elected as congressmen because he regarded them as ‘the true representatives of the great American interest,’ unlike the avaricious merchants who ‘have no country.’ Factory workers, merchants and stockbrokers would never feel bound to their country like farmers who worked the soil. ‘The small landholders are the most precious part of a state,’ Jefferson insisted, and had written into his draft for the Virginia constitution that every free person was to be entitled to fifty acres of land (though he had failed to get this provision passed). It was an idea that Humboldt shared because the small farmers whom he had met in South America had developed ‘the sentiment of liberty and independence.’

At that time farming provided the livelihood for most Americans but the founding fathers also believed that free husbandmen with their small self-sufficient farms would be the foot soldiers of the infant nation. And with the elevation of the small farmer as something like the guardian of liberty, seemingly mundane tasks such as collecting manure, planting seeds and devising crop rotations became elemental parts of nation building. Ploughing, planting and vegetable gardening were more than profitable occupations, they became political acts that brought freedom and independence. The improvement of agriculture was therefore a republican endeavour because—as Madison said—the more prosperous farmers lived in the country ‘the more free, the more independent, and the more happy must be the society itself.’ Jefferson echoed this sentiment when he wrote ‘Cultivators of the earth are the most vigorous, the most independent, the most virtuous.’

Washington’s agricultural methods were so innovative that many regarded him as ‘the first farmer in America.’ Jefferson said that Madison was ‘the best farmer in the world.’ And an American scientist declared Jefferson to be ‘the enlightened philosopher—the distinguished naturalist—the first statesman on earth, the friend, the ornament of science . . . the father of our Country, the faithful guardian of our liberties.’ In fact, Jefferson was said to be more proud about his election as the President of the American Philosophical Society (the foremost scientific society in the country), than as the President of the United States.

At the same time, nature gave the thirteen states a national identity that still resonates today. After the War of Independence in 1783, the former colonies had to mature from being a war alliance to becoming a united nation. It was the Constitution that welded them together politically, legally and economically, but it was America’s nature, soil and plants that provided a transcendent feeling of nationhood. Europe had antiquity and the ancient ruins, but Americans had to find something that made the New World better than the Old World and that bound them together as a country. They found it in America’s spectacular landscape and imbued nature with patriotic significance. It was perfect articulation of a distinct national identity—of a country that was young, strong and fertile.

The very wildness of America’s rugged mountains, vast plains and untamed forests became the embodiment of a nation that had freed itself from the shackles of tyranny. The New World’s virgin landscape, fertile, imposing and wild, was untainted by history—by contrast, Europe’s antiquity became synonymous in the American mind with despotism. Why should they admire ‘the temples which Roman robbers have reared,’ one American poet wrote, or castles that were

the emblem of monarchs when the native wilderness was untouched by the blood of tyrants? The forest, the *North American Review* proclaimed in 1837, was ‘one of the principal sources of an ardent and deep-felt patriotism.’ The wilderness, another writer argued some years later in the mid-nineteenth century, had long confirmed ‘our destiny as a country.’

Already in the early 1780s Jefferson had celebrated American nature in his only published book *Notes on the State of Virginia*. He had written that the Potomac passage through the Blue Ridge Mountains was ‘one of the most stupendous scenes in nature’ and that the Natural Bridge was ‘the most sublime of Nature’s works.’ The founding fathers understood the potential of the beauty and vastness of America’s natural scenery as a reflection of a strong nation. Washington wanted artists to paint the natural wonders of the continent and Jefferson had asked the artist John Trumbull to paint the Natural Bridge so that he could present ‘to the world this singular landscape, which otherwise some bungling European will misrepresent.’

Where previous generations had regarded America’s untamed landscape as a hostile environment, which was an obstacle to farming and settlement, it now became an object of national pride—and American painters (such as those from the Hudson River School) began to paint America’s natural scenery in all its glory.

One of the most telling incidents of the importance of nature for the creation of the nation is a letter that Washington wrote in August 1776, on the eve of the Battle of New York. More than 30,000 British troops had landed on America’s shores and as the city braced itself for the first, and largest battle of the War of Independence, Washington wrote a letter to his estate manager in Mount Vernon, asking him to plant a new garden. With the chaos of cannons and of blood looming, Washington asked his estate manager to rip out the old garden and to plant a new one—one that consisted of native American species only—soaring pines and tulip poplars, alabaster dogwood, stately red cedars and pink red bud. As the young nation faced its first military confrontation in the name of liberty and independence, Washington decided that Mount Vernon was to be an all American garden where English trees were not allowed to claw their roots in his soil. It was his horticultural Declaration of Independence.

III. The Founding Fathers and Humboldt’s Ideas of Nature: James Madison’s 1818 Environmental Speech

In May 1804, Humboldt announced his intention to visit the U.S. in a letter to Madison: ‘After having witnessed the great spectacle of the majestic Andes and the grandeur of the physical world I intended to enjoy the spectacle of a free people worthy of a great destiny.’ Politics and nature belonged together—an idea that Humboldt would be discussing with the Americans. Humboldt arrived in Washington, D.C. in June 1804 and spent several days with Thomas Jefferson, James Madison, and Secretary of the Treasury, Albert Gallatin. Humboldt was the ‘object of universal attention,’ the scientist Caspar Wistar said (he had met Humboldt in Philadelphia). Gallatin thought meeting Humboldt was an ‘exquisite intellectual treat.’ Humboldt talked and talked, Gallatin noted, ‘twice as fast as anybody I know.’ He spoke English with a German accent but also German, French and Spanish, ‘mixing them together in rapid Speech.’ He was a ‘fountain of knowledge which flows in copious streams.’ They learned more from him in two hours than they would from reading books for two years, Gallatin said. Humboldt was a

‘very extraordinary man,’ Gallatin told his wife. Jefferson agreed—Humboldt was ‘the most scientific man of his age.’ And Humboldt was thrilled to meet them. He didn’t even mind the unbearable humidity of the Washington summer, because the ‘best air of all is breathed in liberty.’

During this one week in Washington, the men talked about nature and politics—about crops and soils and the shaping of nations. Humboldt, like Jefferson, believed that only an agrarian republic brought happiness and independence. Colonialism, by contrast, brought destruction. The Spanish had arrived in South America to obtain gold and timber—‘either by violence or exchange,’ Humboldt would write later, and motivated only by ‘insatiable avarice.’ The Spanish had annihilated ancient civilizations, native tribes and stately forests. The portrait that Humboldt brought back from Latin America was painted in the vivid colours of a brutal reality—all underpinned by hard facts, data and statistics. He was the first to relate colonialism to the devastation of the environment.

When Humboldt left the United States, he had forged lifelong friendships with the three politicians and they would correspond to each other until they died (with Humboldt always sending his latest publications to them). ‘The days I spent with you in Washington were the best of my life,’ Humboldt wrote to Madison on his departure. He had also rejoiced to see Jefferson as ‘the first Magistrate of this great republic living with the simplicity of a philosopher’ and a few years later expressed his delight in thinking of the President as the ‘statesman, who established the welfare of an entire continent, among his magnolia trees.’ Humboldt also wrote to Madison in admiration ‘I know of no other Minister of State equally interested in the cultivation of the ground on which he lives.’

Humboldt promised to return to explore the western U.S. but he didn’t because he was too busy over the next decades publishing the results of his South American expedition. But for the rest of his life he said ‘I am half an American’ and claimed that the U.S. was his ‘second home.’ And though Humboldt never returned, his influence on American environmentalism was huge.

Using his political platform, Madison continued to spread Humboldt’s ideas by applying Humboldt’s observations from South America to the United States. In a widely circulated speech that he gave to the Agricultural Society in Albemarle, Virginia, in May 1818, a year after his retirement from the presidency, Madison repeated Humboldt’s warnings about deforestation and highlighted the catastrophic effects of large-scale tobacco cultivation on Virginia’s once fertile soil. The speech carried the nucleus of American environmentalism.

Madison wanted to instill in his fellow Americans his perception of nature and put an end to the destruction of once fertile soil and the increasing exploitation of timber resources. He knew that man’s reckless use of his environment would change only if Americans understood the broader context of agriculture and its pivotal place within the delicate balance between man and nature. Madison told the members of the Agricultural Society of Albemarle that nature was not ‘subservient’ to the use of man. Not everything could be appropriated, Madison said, for the ‘increase of the human part of the creation’—if it was, nature’s balance would collapse.

Like Humboldt, Madison saw nature as a web of life where animals and plants were part of the same environment. Every animal, plant (and of course humans) played a part. Animals respired air, Madison said, that was ‘unfitted for their further uses,’ but plants reversed the process. And so, ‘if the whole class of vegetables [plants] were extinguished,’ he concluded, animals would not survive, as they were dependent upon each other. He looked at depleted soils and demanded that man had to return to nature what he took from nature—‘vegetable matter which springs from earth,’ he said, must ‘retur[n] to the earth.’

Madison also went to lengths to explain the importance of the climate system and the atmosphere, which he viewed as vital foundations of life and country. In that same 1818 speech he said:

But, although no determinate limit presents itself to the increase of food, and to a population commensurate with it, other than the limited productiveness of the earth itself, we can scarcely be warranted in supposing that all the productive powers of its surface can be made subservient to the use of man, in exclusion of all the plants and animals not entering into his stock of subsistence; that all the elements and combinations of elements in the earth, *the atmosphere and the water*, which now support such various and such numerous descriptions of created beings, animate and inanimate, could be withdrawn from that general destination, and appropriated to the exclusive support and increase of the human part of the creation; so that the whole habitable earth should be as full of people, as the spots most crowded now are or might be made, and as destitute as those spots, of the plants and animals not used by man.

The supposition cannot well be reconciled with that symmetry in the face of nature, which derives new beauty from every insight that can be gained into it. It is forbidden also, by the principles and laws which operate in various departments of her economy, falling within the scope of common observation, as well as within that of philosophic researches.

Animals, including man, and plants may be regarded as the most important part of the terrestrial creation. They are pre-eminent in their attributes; and all nature teems with their varieties and their multitudes, visible and invisible. *To all of them, the atmosphere is the breath of life. Deprived of it, they all equally perish.* But it answers this purpose by virtue of its appropriate constitution and character. What are these?

The atmosphere is not a simple but a compound body. In its least compound state, it is understood to contain, besides what is called vital air, others noxious in themselves, yet without a portion of which, the vital air becomes noxious. But the atmosphere in its natural state, and in its ordinary communication with the organized world, comprises various ingredients or modifications of ingredients derived from the use made of it, by the existing variety of animals and plants. The

exhalations & perspirations, the effluvia and transpirations of these, are continually charging the atmosphere with a heterogeneous variety and immense quantity of matter, which together must contribute to the character which fits it for *its destined purpose, of supporting the life and health of organized beings. Is it unreasonable to suppose, that if, instead of the actual composition and character of the animal and vegetable creation, to which the atmosphere is now accommodated, such a composition and character of that creation, were substituted, as would result from a reduction of the whole to man and a few kinds of animals and plants; is the supposition unreasonable, that the change might essentially affect the aptitude of the atmosphere for the functions required of it; and that so great an innovation might be found, in this respect, not to accord with the order and economy of nature?*

The immensity of the atmosphere, compared with the mass of animals and vegetables, forms an apparent objection only to this view of the subject. *The comparison could at most suggest questions as to the period of time necessary to exhaust the atmosphere of its unrenewed capacity to keep alive animal or vegetable nature, when deprived, either, of the support of the other.*¹

In 1818, Madison's concern for the atmosphere related to deforestation, degradation of soil, and agricultural practices similar to those that Humboldt had witnessed in Venezuela and which could create an imbalance in the order of nature. There was no doubt for Madison that farmers should come together in what he called 'Patriotic Societies' (like the Agricultural Society of Albemarle) to improve soils and protect the balance of nature. He accused those who relentlessly exploited the land: 'The profit, where there is any, will not balance the loss of intrinsic value sustained by the land.' He talked of 'scars and sores' on the land and like Humboldt understood the ecology of a forest. One of the most telling sentences in his speech was his demand 'to make the thieves restore as much as possible of the stolen fertility.'

Decades before Transcendentalists such as Henry David Thoreau called for protection of America's nature, Madison warned about man's destructive force. The preservation of the environment was essential for the survival of mankind, Madison believed, not so much in order to live in romantic harmony with nature but to live off it without destroying it. The reasons were economic rather than idealistic, but the goal was the same.

Madison did not see nature through a romantic lens of transcendent beauty but as a fragile ecological system that could be easily destroyed by mankind. As such the origin of the notion of conservation arguably lies not, as generally assumed, in the mid-nineteenth century with Henry David Thoreau or George Perkins Marsh's *Man and Nature* (1864)—a movement—but in the previous century with men like the founding fathers. Benjamin Franklin expressed the sentiment when he talked of the 'loss for wood'—and as always he tried to tackle the problem with a

¹ 'Address to the Agricultural Society of Albemarle, 12 May 1818', *Founders Online*, National Archives, last modified June 29, 2017, <http://founders.archives.gov/documents/Madison/04-01-02-0244> (emphases added) (**Exhibit D**).

practical solution, designing the fuel-efficient Pennsylvania fireplace in order to reduce timber consumption. Similarly, Washington had complained that ‘the waste which has been committed on my timber and Wood hitherto, has really been shameful.’ Jefferson had written to his overseer that ‘we must use a good deal of economy in our wood’ and John Adams had instructed on buying a forest plot: ‘Pray dont let a Single Tree be cut.’

The biggest mistake, Madison said in his speech, was the ‘excessive destruction of timber.’ He then called for ‘plantations of trees’ (his friend William Thornton, the first architect of the Capitol, had four years previously also feared that ‘by clearing Lands, whole Families of plants are likely to be lost’). Madison was also the first American, and certainly the first politician, who put aside a piece of forest to protect it—not on public land but rather on his plantation Montpelier in Virginia. No tree was allowed to be felled and today, his 200-acres are still protected as the James Madison Landmark Forest. It is my expert opinion that Madison’s speech to the Agricultural Society is one of the founding documents of this nation and remains highly relevant today in the face of the climate crisis.

In no other country, one magazine reported in 1819, would heads of state return to their private lives to promote agriculture, botany and other useful sciences that add ‘to the welfare of their country and of mankind in general.’ Only in America ‘we have witnessed, and still witness, such examples in the retired lives of Washington, Adams, Jefferson and Madison.’ By the 1830s, the revolutionary generation had gone but they had left a legacy that continues to this day. Not only did they create the United States in a political sense, they had also understood the importance of nature for their country. The American landscape, forests, soil and plants made the nation. Nature was the backbone to the economy—feeding, clothing and sheltering the people. The United States was a republic of farmers, and the opening of the West extended the vision of an agrarian people across a whole continent. At the same time the vast landscapes and stately forests became monuments of the country’s national identity.

IV. Humboldt’s Influence on American Writers and Thinkers

After Humboldt returned to Europe, he settled first in Paris and then from the mid-1820s in Berlin. Over the next decades he published several dozen books, many of which were aimed at a general audience (he brought together evocative landscape descriptions and scientific observations, thereby creating a completely new literary genre). Several became huge international bestsellers and were published in many languages. The book that made him famous in America was *Cosmos* (first published in 1845)—a book that was unlike any other ever published. In *Cosmos*, Humboldt took his readers on a thrilling journey from outer space to Earth, bringing together distant nebulae, the migration of the human race and erupting volcanoes. He wrote about botany, landscape painting, and nature in poetry. It was like a vivid kaleidoscope of correlations that spanned the entire universe— a portrait of nature pulsating with life—‘a wonderful web of organic life,’ as he called it. At a time when other scientists crawled into their ever-narrowing disciplines, Humboldt did exactly the opposite: he brought everything together.

Cosmos was the book that made Humboldt a household name in the United States and it shaped two generations of American scientists, artists, writers and poets. Walt Whitman wrote his celebrated poetry collection *Leaves of Grass* with a copy of one of Humboldt’s books on his

desk. Whitman even composed a poem called ‘Kosmos’ and proclaimed himself ‘a kosmos’ in his famous poem ‘Song of Myself.’ Painter Frederic Edwin Church followed Humboldt’s footsteps through South America. Church’s magnificent *The Heart of the Andes* (which is today at the Metropolitan Museum of Art in New York) was his artistic answer to Humboldt’s new concept of nature. They lived in what was now claimed to be the ‘age of Humboldt.’

Ralph Waldo Emerson was one of the first to obtain a copy of *Cosmos*. ‘The wonderful Humboldt,’ he wrote in his journal, ‘with his extended centre & expanded wings, marches like an army, gathering all things as he goes.’ No one, Emerson said, knew more about nature than Humboldt. He had swept clean ‘this sky full of cobwebs.’ Another American writer who loved Humboldt’s work was Edgar Allen Poe, whose last major work—the 130-page prose poem *Eureka*, published in 1848—was dedicated to Humboldt and was a direct response to *Cosmos*. *Eureka* was Poe’s attempt to survey the universe—including all things ‘spiritual and material’ echoing Humboldt’s approach of including the external and internal world. The universe, Poe wrote, was ‘the most sublime of poems.’

By 1858, a year before his death, Humboldt had become the most famous scientist of his age, not just in Europe but across the world. His portrait was placed in the Great Exhibition in London and also hung in palaces as remote as that of the King of Siam in Bangkok. His birthday was celebrated as far away as Hong Kong and one American journalist claimed: ‘Ask any schoolboy who Humboldt is, and the answer will be given.’ In the same year, the US Secretary of War, John B. Floyd, sent Humboldt nine North American maps that showed all the different towns, counties, mountains and rivers that were named after him. His name, Floyd wrote, was a ‘household word’ throughout the country. In the past it had even been suggested that the Rocky Mountains should be renamed ‘Humboldt Andes’.

On 14 September 1869, one hundred years after his birth, Alexander von Humboldt’s centennial was celebrated across the world. There were parties in Australia, Buenos Aires, Mexico City, Egypt and all over Germany. There were festivities in Moscow where Humboldt was called the ‘Shakespeare of sciences’ but the greatest commemorations were in the United States—from San Francisco to Richmond, and from Chicago to Charleston, the nation saw street parades, sumptuous dinners and concerts. In Cleveland some 8,000 people took to the streets and in Syracuse another 15,000 joined a march that was more than a mile long. President Ulysses Grant attended the Humboldt celebrations in Pittsburgh together with 10,000 revellers who brought the city to a standstill. In Boston, Ralph Waldo Emerson told the city’s grandees that Humboldt was ‘one of those wonders of the world’ and thousands celebrated in Philadelphia and many more other American cities. The front page of *The New York Times* was entirely dedicated to Humboldt and 25,000 people marched from the Bowery and along Broadway to Central Park to unveil a bust of Humboldt (which is still there today)—to honor a man ‘whose fame no nation can claim,’ as *The New York Times* wrote.

The historic and long-standing recognition and celebration of Humboldt in the United States is testament to the resonance and inspiration of his nature teachings on that young nation and its political and thought leaders.

A. Henry David Thoreau

Henry David Thoreau left his cabin at Walden Pond in 1847, and would eventually turn his two years there into one of the most famous pieces of American nature writing: *Walden*, which he published in 1854. But Thoreau struggled to compose it. He drafted and redrafted the manuscript and finally gave up and put it away. The reason was that he was torn between science and poetry because Thoreau observed nature meticulously like a scientist but also adored its beauty, finding the two difficult to balance. He observed nature, measured the depth of streams, counted the frozen bubbles that were captured in the icy surface of the pond, measured the wing span of a moth, as well as counting tree rings trying to understand what it all meant. What kind of science was this, Thoreau asked, ‘which enriches the understanding but robs the imagination?’

This was exactly what Humboldt had written about in *Cosmos*. Nature, Humboldt explained, should be described with scientific accuracy but without being ‘deprived thereby of the vivifying breath of imagination.’ Shortly after his return from Walden Pond Thoreau read Humboldt’s most popular books *Cosmos*, *Views of Nature* and *Personal Narrative* and discovered a new world. Humboldt showed Thoreau how to weave together science and poetry, the particular and the whole, the factual and the wonderful. *Cosmos* illustrated that a vast array of individual observations created a unified portrait of nature, each fact and detail weaving together into an interconnected whole. There was ‘unity in diversity,’ Humboldt wrote.

Thoreau began, as he said, to ‘look at Nature with new eyes—eyes that Humboldt had given him. And then, after reading Humboldt’s books, Thoreau unpacked his manuscript and completely re-wrote *Walden*—the book, which we know today, deeply inspired by Humboldt. His name appears regularly in Thoreau’s journals and published work but what is particularly interesting is how Thoreau transports Humboldt’s ideas into his much smaller world in Concord, MA. What the adventurous explorer Humboldt had observed across the globe during his expeditions, Thoreau found at home. The thundering Orinoco became a little stream in Concord, the neighboring hills became the Andes, and the Atlantic was ‘a large Walden Pond’. For Thoreau everything was connected and shaped by the same forces. During a winter storm, one cold January morning, he watched the dance of the snowflakes and wrote in his diary ‘the same law that shapes earth—star shapes the snow—star’, concluding that this was ‘Order. Kosmos.’ *Walden* was Thoreau’s mini-*Cosmos* of one particular place, an evocation of nature in which everything was connected, packed with details of animal habits, blooms and the thickness of ice on the pond.

As early as 1851, Henry David Thoreau called for the preservation of forests. He said, ‘in Wilderness is the preservation of the World.’ In 1859 he concluded that every town should have a forest of several hundred acres ‘inalienable forever.’ Today Thoreau is one of the most widely read and beloved American writers. He followed Humboldt in his belief that the ‘whole’ could only be comprehended by understanding the connections, correlations and details. Everything was interwoven.

B. George Perkins Marsh

Humboldt also shaped the beliefs of another American proto-ecologist, George Perkins Marsh, the author of *Man and Nature*, published in 1864 and one of the most important environmental texts ever published in the United States. *Man and Nature* was the first work of natural history to fundamentally influence American politics. It was, as the American writer and environmentalist Wallace Stegner later said, the ‘rudest kick in the face’ to America’s optimism. As the American ambassador in Turkey and then Italy, Marsh traveled extensively in Europe and the Middle East where he observed, through the lens of Humboldt’s writings, landscapes that were damaged by thousands of years of agricultural activity. He called Humboldt ‘the great apostle’ and extended his warnings about a devastated planet: If nothing changed, Marsh foretold, Earth would be reduced to a ‘shattered surface [and] climatic excess.’ *Man and Nature* led to the passage of the 1873 Timber Culture Act, which encouraged settlers on the Great Plains to plant trees. It also prepared the ground for the 1891 Forest Reserves Act, which took some of its wording from Marsh and from Humboldt’s earlier ideas.

Marsh began writing *Man and Nature* in the spring of 1860 and took Humboldt’s early warning about deforestation to its full conclusion. *Man and Nature* told a story of destruction and avarice, of extinction and exploitation, as well as of depleted soil and torrential floods. At the time there seemed to be no limit to the ability nor to the greed of humankind. Lakes, ponds and rivers that had once abounded with fish had become eerily lifeless. Marsh was the first to explain why. Overfishing was partly to blame, but so too was pollution from industry and manufacturing. Chemicals poisoned the fish, Marsh warned, while the milldams stopped their migration upriver and sawdust clogged their gills. A stickler for details, Marsh underpinned his arguments with facts. He didn’t just state that fish disappeared or that railways were eating up forests, he also added detailed statistics of fish exports from across the world and exact calculations of how much timber was needed for each mile of rail track. Marsh talked about the evils of deforestation. He explained how forests protected the soil and natural springs. Once the forest was gone, the soil lay bare against winds, sun and rain. The earth would no longer be a sponge but a dust heap. As the soil was washed off, all goodness disappeared and ‘thus the earth is rendered no longer fit for the habitation of man,’ Marsh concluded. It made for gloomy reading. The damage caused by just two or three generations was as disastrous, he said, as the eruption of a volcano or an earthquake. ‘We are,’ he warned prophetically, ‘breaking up the floor and wainscoting and doors and window frames of our dwelling.’

Humboldt had taught Marsh about the connections between humankind and the environment. And in *Man and Nature* Marsh reeled off one example after another of how humans interfered with nature’s rhythms. ‘Man has too long forgotten that the earth was given to him for usufruct alone, not for consumption.’ Man had long forgotten that the earth was not given to him for ‘consumption.’ The produce of the earth was squandered, Marsh argued, with wild cattle killed for their hides, ostriches for their feathers, elephants for their tusks and whales for their oil. Humans were responsible for the extinction of animals and plants, Marsh wrote in *Man and Nature*, while the unrestrained use of water was just another example of ruthless greed. Irrigation diminished great rivers, he said, and turned soils saline and infertile. Like Humboldt he talked about a web of life in which ‘all nature is linked together by invisible bonds, and every organic

creature, however low, however feeble, however dependent, is necessary to the well-being of some other.’ He also wrote of the importance of climatic studies and writings by many scientists already documenting the chemical changes of the atmosphere and the need for more data on man’s impact. He explained the importance of the forests and soils on the quality of the atmosphere.

Marsh’s vision of the future was bleak. He talked about the ‘hostile influence of man’ and that the laying waste of the earth was threatening its habitability for humans. If nothing changed, he believed, the planet would be destroyed, ‘the result of man’s ignorant disregard of the laws of nature.’ He saw the American landscape magnified through what he had observed during his travels, from the overgrazed hills along the Bosphorus near Constantinople to the barren mountain slopes in Greece. Great rivers, untamed woods and fertile meadows had disappeared. Europe’s land had been farmed into ‘a desolation about as complete as that of the moon.’ The Roman Empire had fallen, Marsh concluded, because the Romans had destroyed their forests and thereby the very soil that fed them. Marsh questioned how much we could repair: ‘how far man can permanently modify and ameliorate those physical conditions of terrestrial surface and climate on which his material welfare depends; how far he can compensate, arrest, or retard the deterioration which many of his agricultural and industrial processes tend to produce; and how far he can restore fertility and salubrity to soils which his follies or his crimes have made barren or pestilential.’

Marsh was telling Americans that they had to act now, before it was too late. ‘Prompt measures’ had to be taken because ‘the most serious fears are entertained.’ Forests needed to be set aside and replanted. Some should be preserved as places of recreation, inspiration and habitat for flora and fauna as an ‘inalienable property’ for all citizens. In his book he also suggested: ‘It is desirable that some large and easily accessible region of American soil should remain, as far as possible, in its primitive condition, at once a museum for the instruction of the student, a garden for the recreation of the lover of nature, and an asylum where indigenous tree, and humble plant that loves the shade, and fish and fowl and four-footed beast, may dwell and perpetuate their kind, in the enjoyment of such imperfect protection as the laws of a people jealous of restraint can afford them.’ Other areas needed to be replanted and managed for a sustainable use of timber. ‘We have now felled forest enough,’ Marsh wrote. Marsh believed that the lessons were buried in the scars that the human species had left on the landscape for thousands of years. ‘The future,’ he said, ‘is more uncertain than the past.’ By looking back, Marsh was looking forward, reminding the nation of its trust responsibility to Posterity.

C. John Muir

It was also Humboldt who inspired John Muir’s ecological thinking. Almost 70 years younger, Muir grew up reading Humboldt’s books. ‘How intensely I desire to be a Humboldt,’ Muir declared when he was in his 20s. Muir’s famous quotation—‘When we try to pick out anything by itself, we find it hitched to everything else in the universe’—owes a great deal to Humboldt’s ideas that nothing, not even the tiniest organism, could be looked at on its own.

Muir left behind heavily annotated copies of Humboldt’s books. Pencil in hand, he scribbled in the margins of his copies, which are now in the special collections of the University of the

Pacific in Stockton. On the endpapers Muir devised his own extensive indexes in which he highlighted passages about the impact of trees on climate, soil and evaporation as well as the destructive force of agriculture and deforestation. When Humboldt wrote about the destructions of forests—Muir underlined it—sentences such as ‘the early colonists imprudently destroyed the forest,’ ‘violation of these monuments of nature’ or ‘the great forests preserve by their shade a certain quantity of moisture in the soil, by sheltering it from the devouring heat of the sun.’ In his book *Personal Narrative*, Humboldt had written (and Muir had highlighted it) that ‘man [was] not being essential to the order of nature’—Muir wrote in his journal: ‘Why ought man to value himself as more than an infinitely small unit of the one great unit of creation?.’

When Muir fought for the creation of Yosemite National Park, he explained that a huge swath of land had to be preserved because Yosemite Valley and its surroundings were as closely related as the ‘fingers to the palm of a hand.’ He was calling upon Humboldt’s description of the web of life or ecosystems as we would call it today (the word ecology was only coined in 1866 by the German scientist Ernst Haeckel who was another follower and admirer of Humboldt’s ideas).

In 1869, the year of Muir’s first summer in Yosemite and also the year that the world celebrated the centenary of Humboldt’s birth, the first transcontinental railway in North America reached the West Coast. Over the past four decades the railway boom had transformed America and during Muir’s first five years in California another 33,000 miles of tracks were added—by 1890 more than 160,000 miles of tracks snaked across the United States. The United States was changing. Every year Americans claimed an additional 15 million acres for fields. With the advent of steam-powered reapers, grain binder machines and combine harvesters that cut, threshed and cleaned grains mechanically, agriculture had become industrialized. The world seemed to spin faster and faster. The 1890s were the first decade without a frontier. ‘The rough conquest of the wilderness is accomplished,’ the American historian Frederick Jackson Turner declared in 1903. By the end of the nineteenth century the United States was the world’s leading manufacturing country, and as farmers moved into the cities and towns, nature became increasingly removed from daily life.

Muir turned his love for nature into activism and began to write and campaign for the creation of a national park in Yosemite. By the turn of the century, Muir had become so famous that President Theodore Roosevelt requested his company on a camping trip to Yosemite. ‘I do not want anyone with me but you,’ Roosevelt wrote in March 1903—two months later, the President, who was an avid naturalist, arrived in the Sierra Nevada. It was here, surrounded by majestic granite rocks and the soaring trees, that Muir convinced the President that the federal government should at last take control of Yosemite Valley away from the state of California and make it part of the larger Yosemite National Park. Humboldt had understood the threat to nature, Marsh had assembled the evidence into one convincing argument, but it was Muir who planted environmental concerns into the wider political arena and the public mind. The idea of a national protest movement on behalf of nature was born.

For the rest of his life Muir fought for the protection of nature. *Man and Nature* had been a wake-up call for some Americans, but where Marsh wrote one book that encouraged the protection of the environment mainly for the economic profit of the country, Muir would publish a dozen books and more than 300 articles that made ordinary Americans fall in love with nature.

Muir wanted them to stare in awe at mountain vistas and towering trees. He could be funny, charming and seductive in his pursuit of this goal.

Muir took the baton of nature writing from Humboldt who had created this new genre—one that combined scientific thinking with emotional responses to nature. Humboldt had dazzled his readers, including Muir, who then in turn became a master of this kind of writing. ‘Nature’ itself, Muir said, was ‘a poet’—he just needed to let it speak through his pens. Humboldt had understood the threat to nature, Marsh had assembled the evidence into one convincing argument, but now Muir brought environmental concerns into the wider political arena and the public mind. Muir was convinced that only ‘Uncle Sam’—the federal government—had the power to protect nature from the ‘fools’ who destroyed trees. It was not enough to designate areas as parks or forest reserves, their protection needed to be watched and enforced.

CONCLUSION

As scientists try to predict the global consequences of climate change and how quickly irreversible catastrophes will befall humanity, Humboldt’s interdisciplinary approach to science and nature, as adopted by American leaders since the beginning of the republic, is more relevant than ever. His beliefs in the free exchange of information, in uniting scientists and in fostering communication across disciplines, are the pillars of science today. His concept of nature as one of global patterns underpins our thinking.

One look at the latest 2014 UN Intergovernmental Panel on Climate Change (IPCC) report shows just how much we are in need of a Humboldtian perspective. The report, produced by over 800 scientists and experts, states that global warming will have ‘severe, pervasive and irreversible impacts for people and ecosystems.’ Humboldt’s insights that social, economic and political issues are closely connected to environmental problems remain resoundingly topical. Just as Humboldt realized that colonies based on slavery, monoculture and exploitation created a system of injustice and of disastrous environmental devastation, so we too have to understand that economic forces and climate change are all part of the same system.

It is my expert opinion that the founding fathers, especially Jefferson, Madison, Washington, Franklin and Adams, would have viewed the past century’s and ongoing exploitation of fossil fuels, forests and agricultural soils to be antithetical to the foundational principles of the republic and to liberty itself. They would likely see in this crisis a great failing of the republican system of government and democracy itself if none of the three branches of government was able to uphold and enforce the inalienable rights on which they founded the nation, least of all was the right to nature.

The ‘breath of life’ that the atmosphere, forests, soils, waters (the climate system) was to the agrarian society in which the founding father gardeners lived was also foundational to the liberties they staked out for their new nation. Nature, and especially human connection to nature, informed the founding father’s politics, their worldview, and was undoubtedly intertwined with the implicit liberties they believed resided in all men. Like their contemporary teacher, Humboldt, the founding fathers believed ‘Nature is the domain of liberty.’

In my expert opinion, the value of nature in balance was so fundamental to the founding fathers and the formative years of the United States of America, that they would not have found it necessary to write it explicitly in the U.S. Constitution, which was more about the political compromises in the operation of federalism that they agreed to make in order to form a more perfect union. Compromising the balance of nature, or the breath of life (the atmosphere) would not have been up for negotiation at the constitutional convention. The Posterity Clause of the Constitution's Preamble speaks to the founding father's desire to create and pass down a nation of liberty and freedom, whose bedrock was not just the piece of animal skin on which those men declared their independence from tyranny or their contract to bind one another and the nation in a republic and in democracy, but the very nature on which all of their lives and livelihoods depended. They set out with their self-evident truths stated eloquently by Thomas Jefferson that 'the land belongs in usufruct to the living,' and shall be protected for Posterity.

There may be no other implicit liberty right more rooted in the history and traditions of the United States than the right to a climate that sustains life, the life that humans have enjoyed for generations and now is catastrophically threatened. In James Madison's words, 'the atmosphere is the breath of life. Deprived of it, they all equally perish.'

Signed this 30th day of March, 2018 in New York, New York.

A handwritten signature in blue ink, appearing to read 'A Wulf'.

Andrea Wulf

EXHIBIT A: CURRICULUM VITAE

Andrea Wulf
110B Chamberlayne Road, London NW10 3JP
United Kingdom
T: +11447931 547045
E: andrea@andreawulf.com

twitter: @andrea_wulf
www.andreawulf.com

Curriculum Vitae

Education:

1999 MA History of Design, Royal College of Art and Victoria & Albert Museum, London
1994 Undergraduate Studies, Cultural Studies, University Lüneburg, Germany
(equivalent to BA)

Other Qualifications and Awards:

2015– 2017 Winner Royal Society Science Book Prize 2016; Winner Costa Biography Award 2015, winner Bayerischer Buchpreis 2016 (Germany); winner James Wright Award for Nature Writing 2016 (Kenyon Review & Nature Conservancy); winner *LA Times* Book Prize 2016; Sigurd F. Olson Nature Writing Award 2016; finalist Andrew Carnegie Medal for Excellence in Non-Fiction 2016 , finalist Kirkus Prize 2015; shortlisted IBW Book Prize; Cundill Prize in Historical Literature Recognition of Excellence 2016; winner Acqui Storia Award 2017 (Italy); Winner Dingle Prize British Society for the History of Science 2017; Winner Sarah Francis Medal for outstanding literary achievements 2017 (Garden Club of America). Shortlisted for the 2017 Smart Book Awards Jagiellonian University & Euclid Foundation), Poland.

2015 10 Best Books of 2015 in New York Times for “The Invention of Nature”.

2013 Eccles British Library Writer in Residence Award

2010 Winner of American Horticultural Society Book Award 2010 & Winner of CBHL 2010 Annual Literature Award (“The Brother Gardeners”)

2008 Longlisted for the Samuel Johnson Prize 2008 (“The Brother Gardeners”)

2008 White House History Fellowship (Organisation of American Historians and White House Historical Association)

2008 – 10 3 International Fellowships at the Robert H. Smith International Center for Jefferson Studies at Monticello, VA

2006 – 7 Wingate Foundation Scholarship

1997 – 99 History of Design MA Course, Royal College of Art and Victoria & Albert Museum, London

1997 – 99 Friends of the V&A Scholarship

1992 – 96 Cultural Studies, University of Lüneburg, Germany

Book Publications

- Forthcoming **The Adventures of Alexander von Humboldt. A Graphic Novel** (Knopf, US and several other countries)
- 2016 **The Private Jefferson** (exhibition catalogue, Massachusetts Historical Society, 2016). Guest curator and essay 'Revolutionary Gardens. Jefferson, Politics and Plants'
- 2015 **The Invention of Nature. Alexander von Humboldt's New World** (Knopf, US). Published in 25 countries. New York Times Best Seller and '10 Best Books of 2015' in *New York Times*. Spiegel Bestseller (Number 2), Germany. The Sunday Times called it 'magnificent' and the *New York Review of Books* described it as 'thrilling'.
- 2012 **Chasing Venus. The Race to Measure the Heavens** (Knopf, US). Published in 24 countries. The *Mail on Sunday* described it as an 'enthraling, nail-biting thriller' and the *Boston Globe* wrote 'here is a book both astrophysicists and poets can understand'.
- 2011 **Founding Gardeners. How the Revolutionary Generation Created an American Eden** (Knopf, US). New York Times Best Seller. The *New York Times* called it an 'illuminating and engrossing new book' and the *Washington Post* praised it as 'lively a deeply researched history'.
- 2008 / 2009 **Brother Gardeners: Botany, Empire and the Birth of an Obsession** (Knopf, US). Book of the Week BBC Radio 4. The *New York Times* called it 'a delightful book ... Wulf's flair for storytelling is combined with scholarship, brio and a charmingly airy style'. The *Independent on Sunday* said it was 'the best book this year'.
- 2005 **This Other Eden. Seven Great Gardens and Three Hundred Years of English History** co-authored with Emma Gieben-Gamal (Little,Brown, UK). Six-part mini-series on BBC Radio 4 Woman's Hour. The *Financial Times* called it a 'masterfully told history of English gardens' and the *Guardian* said 'a delightful hybrid of novel and reference book'.

Additional Professional Experience

(see www.andreawulf.com for a more extensive publication list)

- Journalism** *New York Times, Wall Street Journal, LA Times, The Atlantic Monthly, Washington Post, Guardian, Times Literary Supplement, Sunday Times, Financial Times, Mail on Sunday.*
- Radio & TV** regular contributor to BBC Radio 4; co-presenter of 4-part BBC 4 TV "British Gardens in Time", 2014; BBC Radio 3, BBC World Service, TV BBC 1 Countryfile, TV CNN News, NPR Diane Rehm Show, NPR One Point, NPR All Things Considered, NPR Science Friday etc., as well as major TV & Radio talk shows in Germany. Currently filming a Humboldt documentary in Europe, US and South America for ZDF (Germany) and Smithsonian Channel (US).
- Lectures** Around 50 lectures a year in the US, Europe and South America, including at the Royal Geographical Society, British Library, Royal Society, American

Philosophical Society, New York Public Library, Monticello, Massachusetts Historical Society as well as universities, botanical gardens, museums, libraries and at festivals, conferences and symposia.

Consultant Clients have included: 'Gardens by the Bay' (National Parks Singapore and Land Design Studio); Ramboll Whitbybird, London (engineering firm); NESTA (National Endowment of Science, Technology and the Arts); Michael Hoppen Gallery, London

Judge Benjamin Franklin House Literary Prize; The John Murray International Non-Fiction Prize

Fellow Member of PEN American Center
Fellow of the Royal Geographical Society
Fellow of the Linnean Society
Member of the Society of Woman Geographers
International Fellow of the Explorer's Club

EXHIBIT B: LIST OF PUBLICATIONS (LAST TEN YEARS)**Book Publications by Andrea Wulf**

- Forthcoming **The Adventures of Alexander von Humboldt. A Graphic Novel** (Knopf, US and several other countries)
- 2016 **The Private Jefferson** (exhibition catalogue, Massachusetts Historical Society, 2016). Guest curator and essay 'Revolutionary Gardens. Jefferson, Politics and Plants'
- 2015 **The Invention of Nature. Alexander von Humboldt's New World** (Knopf, US & John Murray Press, UK. Published in 24 countries. New York Times Best Seller and voted by the *New York Times* as '10 Best Books of 2015'. The Sunday Times called it 'magnificent' and the *New York Review of Books* described it as 'thrilling'. Winner of 9 Awards (including the Royal Society Science Book Prize 2016, *LA Times* Book Prize 2016, Costa Biography Award 2015) and shortlisted for 6 Awards.
- 2012 **Chasing Venus. The Race to Measure the Heavens** (William Heinemann, UK & Knopf US). Published in 9 countries. The Mail on Sunday described it as an 'enthraling, nail-biting thriller' and the Boston Globe wrote 'here is a book both astrophysicists and poets can understand'.
- 2011 **Founding Gardeners. How the Revolutionary Generation Created an American Eden** (William Heinemann, UK & Knopf US). New York Times Best Seller. The New York Times called it an 'illuminating and engrossing new book' and the Washington Post praised it as 'lively and deeply researched history'.
- 2008 / 2009 **Brother Gardeners: Botany, Empire and the Birth of an Obsession** (William Heinemann, UK & Knopf US). Book of the Week on BBC Radio 4. The New York Times called it 'a delightful book ... Wulf's flair for storytelling is combined with scholarship, brio and a charmingly airy style'. The Independent on Sunday said it was 'the best book this year'.
- 2005 **This Other Eden. Seven Great Gardens and Three Hundred Years of English History** co-authored with Emma Gieben-Gamal (Little,Brown, UK). Six-part mini-series on BBC Radio 4 Woman's Hour. The Financial Times called it a 'masterfully told history of English gardens' and the Guardian said 'a delightful hybrid of novel and reference book'.

Radio & TV

Regular contributor to BBC Radio 4; co-presenter of 4-part BBC 4 TV "British Gardens in Time", 2014; BBC Radio 3, BBC World Service, TV BBC 1 Countryfile, TV CNN News, NPR Diane Rehm Show, NPR One Point, NPR All Things Considered, NPR Science Friday etc., as well as major TV & Radio talk shows in Germany. Currently filming a TV documentary about Alexander von Humboldt for ZDF (Germany) and the Smithsonian Channel (US). For more

detailed information and international interviews see:
<http://www.andreawulf.com/interviews/>

Articles by Andrea Wulf (past 10 years)

November 2017, The Atlantic, 'Walden wasn't Thoreau's Masterpiece'
<https://www.theatlantic.com/magazine/archive/2017/11/what-thoreau-saw/540615/>

October 2017, Geographical Review, 'Man and Nature. George Perkins Marsh and Alexander von Humboldt'

10 July 2017, The Guardian: 'Science Books that Inspired Scientists and Writers'
<https://www.theguardian.com/books/2017/jul/10/science-writers-books-inspired-them-brian-cox-garry-kasparov>

November 2016, New Philosopher, 'In Awe of Nature: Alexander von Humboldt'
<http://www.andreawulf.com/2016/11/new-philosopher-in-awe-of-nature-alexander-von-humboldt.html>

7 June 2016, The Guardian, 'Paperback Writer: Andrea Wulf'
<https://www.theguardian.com/books/2016/jun/07/andrea-wulf-a-journey-through-thousands-of-books-and-spectacular-landscapes>

7 June 2016, The Atlantic: "Theophrastus. The Unsung Hero of Western Science" by Andrea Wulf
<http://www.theatlantic.com/science/archive/2016/06/the-man-who-invented-botany/485780/>

16 May 2016, Wall Street Journal, 'Turning Science into Art', Alexander von Humboldt and Frederic Edwin Church
<http://www.wsj.com/articles/turning-science-into-art-1463433045>

7 March 2016, The Atlantic: "Thomas Jefferson's Quest to Prove America's Natural Superiority" by Andrea Wulf
<http://www.theatlantic.com/science/archive/2016/03/jefferson-american-dream/471696/>

12 February 2016, The Atlantic: "Venus, the Best and Brightest" by Andrea Wulf
<http://www.theatlantic.com/science/archive/2016/02/but-what-about-venus/459939/>

5 February 2016, Geographical (Royal Geographical Society), Alexander von Humboldt and infographics
<http://geographical.co.uk/places/mapping/item/1542-the-invention-of-nature>

19 January 2016, The Atlantic: "Sibylla Maria Merian. The Woman Who Made Science Beautiful" by Andrea Wulf
<http://www.theatlantic.com/science/archive/2016/01/the-woman-who-made-science-beautiful/424620/>

23 December 2015, The Atlantic Monthly, 'The Forgotten Father of Environmentalism'

<http://www.theatlantic.com/science/archive/2015/12/the-forgotten-father-of-environmentalism/421434/>

17 December 2015, Foreign Policy, 'Paris Climate Change Summit and Alexander von Humboldt'

<http://www.andreawulf.com/2015/12/foreign-policy-the-19th-century-saviour-for-21st-century-climate-change.html>

1 November 2015, BA Highlife, 'Alexander von Humboldt: the Lost Hero of Science'

<http://highlife.ba.com/articles/alexander-von-humboldt-the-lost-hero-of-science>

21 October 2015, The Independent, Excerpt from 'The Invention of Nature'

<http://www.independent.co.uk/news/people/profiles/alexander-von-humboldt-the-eccentric-explorer-was-the-most-famous-man-in-the-world-after-napoleon-a6703346.html>

5 July 2016, LA Times, op-ed 'Alexander von Humboldt: The Man who Made Nature Modern'

<http://www.latimes.com/opinion/op-ed/la-oe-wulf-rediscovering-alexander-von-humboldt-20150705-story.html#page=1>

19 April 2013, New York Times, "A Man For All Seasons" by Andrea Wulf

http://www.nytimes.com/2013/04/21/books/review/a-man-for-all-seasons.html?ref=books&_r=1&

February 2013, The English Garden, "Georgian. Plants from Abroad" by Andrea Wulf

3 June 2012, LA Times, "Venus Chasers of the 18th Century", op-ed by Andrea Wulf

<http://articles.latimes.com/2012/jun/03/opinion/la-oe-0603-wulf-venus-science-20120603>

June 2012, Astronomy Now, "The Royal Society and the 1761 Transit of Venus", by Andrea Wulf

June 2012, London Library Magazine, "A Celestial Encounter" by Andrea Wulf

12 May 2012, Daily Mail, "Tiny Black Dot that Unlocks the Universe" by Andrea Wulf

20 April 2012, Wall Street Journal, "A Celestial Event That Sparked a Revolution", by Andrea Wulf

http://online.wsj.com/article/SB10001424052702303513404577353802012350434.html?mod=WSJ_LifeStyle_Lifestyle_5

29 May 2011, LA Times, "Gardening as politics: Digging the Founding Gardeners", op-ed by Andrea Wulf

<http://articles.latimes.com/2011/may/29/opinion/la-oe-wulf-gardens-20110529>

23 February 2011, Daily Telegraph, "The land of the free has been shaped by the plants it raises" by Andrea Wulf

<http://www.telegraph.co.uk/gardening/8338985/The-land-of-the-free-has-been-shaped-by-the-plants-it-raises.html>

January 2011, Opera Now, "Cry Freedom"

Winter 2009, Kew Magazine, "Meeting of Minds"

Summer 2009, Kew Magazine, "The Flowering of a Glorious Obsession"

25 April 2009, Wall Street Journal, "The Roots of a Gardening Obsession"
<http://online.wsj.com/article/SB124061520220654895.html#printMode>

April 2009, Early American Life, "The Brother Gardeners"

24 March 2009, The Guardian, "Politics in Spades: Why the Obama Veg Patch Matters"
<http://www.guardian.co.uk/lifeandstyle/2009/mar/24/gardens-michelle-obama>

February 2009, The Garden (RHS), "Remote Rescues"

Autumn 2008, Bedfordshire County Life Magazine, "John Russell, the 4th Duke of Bedford and the Brother Gardeners"

Autumn 2008, Kew Magazine, "The Seeds of Change. John Bartram's Trees at the Royal Botanic Garden, Kew"

18 August 2008, The Guardian, "Green-fingered Grief Sweeps the Nation"
<http://www.guardian.co.uk/lifeandstyle/2008/aug/18/gardens.gardeningadvice>

June 2008, The Garden (RHS), "Franklinia alantamaha"

20 May 2008, The Guardian, "How Does Your Garden Grow"
<http://lifeandhealth.guardian.co.uk/gardens/story/0,,2281049,00.html>

5 May 2008, The Guardian, "Steal Magnolias"
<http://www.guardian.co.uk/environment/2008/may/05/houseandgarden.gardens>

May 2007, The Garden (RHS), "Carl Linnaeus. In a Class of his Own"

Reviews by Andrea Wulf (past 10 years)

31 August 2017, New Statesman, 'Charles Darwin. Victorian Mythmaker' by A.N. Wilson
<https://www.newstatesman.com/culture/books/2017/08/wilson-makes-unconvincing-attempt-kick-darwin-his-throne>

21 October 2016, New York Times, 'The Moth Snow Storm. Nature and Joy' by Michael McCarthy
https://www.nytimes.com/2016/10/23/books/review/moth-snowstorm-michael-mccarthy.html?_r=0

10 October 2016, Washington Post, 'The Hidden Life of Trees' by Peter Wohlleben
https://www.washingtonpost.com/opinions/the-subtle-communication-skills-of-trees/2016/10/05/e70f87a8-73c3-11e6-be4f-3f42f2e5a49e_story.html?utm_term=.4f22aaf91430

1 October 2016, Guardian, 'The Making of the British Landscape' by Nick Crane
<https://www.theguardian.com/books/2016/sep/30/making-of-british-landscape-nicholas-crane-review>

1 June 2016, New York Times Book Review: “The Hour of Land” by Terry Tempest Williams
<http://www.nytimes.com/2016/06/05/books/review/the-hour-of-land-by-terry-tempest-williams.html>

1 April 2016, Financial Times: “No Need for Geniuses: Revolutionary Science in the Age of the Guillotine” by Steve Jones
<https://next.ft.com/content/5771a778-f675-11e5-803c-d27c7117d132>

25 March 2016, The Guardian: “A Full House of Daughters” by Juliet Nicolson
<https://www.theguardian.com/books/2016/mar/25/a-house-full-of-daughters-juliet-nicolson-review>

26 February 2016, New York Times Book Review: “Weatherland” by Alexandra Harris
<http://www.nytimes.com/2016/02/28/books/review/weatherland-by-alexandra-harris.html>

8 January 2016, Wall Street Journal: “The Last Volcano” by John Dvorak
<http://www.wsj.com/articles/hot-on-the-trail-of-molten-lava-1452285649>

Wall Street Journal: “Books of the Year 2015 – Who Read What”

22 November 2015, Mail on Sunday: “Cabaret of Plants” by Richard Mabey
<http://andreawulf.typepad.com/files/review-of-mabeys-cabaret-of-plants.pdf>

20 November 2015, Publishers Weekly, “Top Authors Pick Their Favourite Books of 2015”
<http://www.publishersweekly.com/pw/by-topic/authors/profiles/article/68754-pw-top-authors-pick-their-favorite-books-of-2015.html>

28 August 2015, Financial Times: “The Invention of Science” by David Wooton
<http://www.ft.com/cms/s/0/1ad4e420-4bd4-11e5-b558-8a9722977189.html>

14 August 2015, Wall Street Journal: “Landfalls” by Naomi J. Williams
<http://www.wsj.com/articles/learning-the-hard-way-1439583608>

31 July 2015, Wall Street Journal: “The Reasons for Flowers” by Stephen Buchmann
<http://www.wsj.com/articles/petal-to-the-metal-1438376696>

10 July 2015, Financial Times: “A Beautiful Question” by Frank Wilczek
<http://www.ft.com/cms/s/0/f82842d6-23d9-11e5-bd83-71cb60e8f08c.html>

12 June 2015, New York Times Book Review: “Backlands” by Victoria Shorr
http://www.nytimes.com/2015/06/14/books/review/backlands-by-victoria-shorr.html?_r=0

14 May 2015, The Guardian: “A Natural History of English Gardening” by Mark Laird
<https://www.theguardian.com/books/2015/may/14/a-natural-history-of-english-gardening-mark-laird-review-groundbreaking>

10 April 2015, Wall Street Journal: “Naturalist’s Paradise” by John Hemmings
<http://www.wsj.com/articles/book-review-naturalists-in-paradise-by-john-hemming-1428683982>

26 December 2014, New York Times Book Review: “A Royal Experiment” by Janice Hadlow

http://www.nytimes.com/2014/12/28/books/review/a-royal-experiment-by-janice-hadlow.html?_r=0

6 June 2014, New York Times Book Review: "Sedition" by Katharine Grant
http://www.nytimes.com/2014/06/08/books/review/sedition-by-katharine-grant.html?_r=1

March 2014, Literary Review: "Round About the Earth" by Joyce E. Chaplin's

10 May 2013, New York Times Book Review: "Equilateral" by Ken Kalfus
http://www.nytimes.com/2013/05/12/books/review/equilateral-by-ken-kalfus.html?_r=1&

New York Times Book Review: "I, Hogarth" by Michael Dean
http://www.nytimes.com/2013/02/03/books/review/i-hogarth-by-michael-dean.html?_r=0

5 January 2013, The Guardian: "How to Create the Perfect Wife" by Wendy Moore
<http://www.guardian.co.uk/books/2013/jan/04/how-create-perfect-wife-review>

14 September 2012, New York Times Book Review: "Beautiful Lies", by Clare Clark
http://www.nytimes.com/2012/09/16/books/review/beautiful-lies-by-clare-clark.html?_r=1&ref=books

22 June 2012, New York Times Book Review: "Mrs Robinson's Disgrace", by Kate Summerscale
<http://www.nytimes.com/2012/06/24/books/review/mrs-robinsons-disgrace-by-kate-summerscale.html?pagewanted=all>

16 March 2012, New York Times Book Review: "Freedom's Gardener" by Myra B. Young
http://www.nytimes.com/2012/03/18/books/review/myra-b-young-armsteads-freedoms-gardener.html?_r=1&ref=books

5 August 2012, New York Times Book Review: "Paradise Lust" by Brook Wilensky-Lanford
http://www.nytimes.com/2011/08/07/books/review/paradise-lust-by-brook-wilensky-lanford-book-review.html?_r=1

13 May 2011, New York Times Book Review: "The Paper Garden" by Molly Peacock
http://www.nytimes.com/2011/05/15/books/review/book-review-the-paper-garden-by-molly-peacock.html?_r=0

20 March 2011, Mail on Sunday "The Omnipotent Magician" by Jane Brown

17 December 2010, New York Times Book Review: "The Women Jefferson Loved" by Virginia Scharff
http://www.nytimes.com/2010/12/19/books/review/Wulf-t.html?_r=2&ref=books&

28 November 2010, Mail on Sunday "City of Sin" by Caroline Arnold

30 July 2010 New York Times Book Review, When London Was Capital of America by Julie Flavell
<http://www.nytimes.com/2010/08/01/books/review/Wulf-t.html?scp=1&sq=%22andrea%20wulf%22&st=cse>

23 May 2010, Mail on Sunday
Gardening Women by Catherine Horwood

2 April 2010, New York Times Book Review
Wild Romance. A Victorian Story of a Marriage, a Trial and a Self-Made Woman by Chloe Schama
<http://www.nytimes.com/2010/04/04/books/review/Wulf-t.html?scp=1&sq=andrea%20wulf&st=cse>

14 March 2010, Mail on Sunday
The Arsenic Century by James Whorton

29 November 2009, Mail on Sunday
Everything You Can Do in the Garden Without Actually Gardening by Philippa Lewis

20 December 2009, New York Times Book Review
Behind Closed Doors. At Home in Georgian England by Amanda Vickery
http://www.nytimes.com/2009/12/20/books/review/Wulf-t.html?_r=2&ref=books

8 November 2009, Mail on Sunday
Sugar: A Bittersweet History by Elizabeth Abbott

16 October 2009, Times Literary Supplement
The Madisons at Montpelier by Ralph Ketcham
The Papers of James Madison, vol.1, ed. David B. Mattern and J.C.A. Stagg

October 2009, Literary Review
Great American Gardens by Tim Richardson

10 July 2009, Times Literary Supplement
The Legacy of the Mastodon by Keith Thomson

15 March 2009, Mail on Sunday
For all the Tea in China by Sarah Rose

February 2009, House & Garden
The Gardens at Kew by Alan Patterson

25 January 2009, Mail on Sunday
Wedlock by Wendy Moore

October 2008, Mail on Sunday
The Age of Wonder by Richard Holmes

October 2008, House & Garden
William Robinson. The Wild Garden by Richard Bisgrove

13 September 2008, The Guardian
Elizabeth in the Garden. A Story of Love, Rivalry and Spectacular Design by Trea Martyn
<http://www.guardian.co.uk/books/2008/sep/13/history2>

24 August 2008, Mail on Sunday
The Biggest Beetroot in the World by Michael Leapman

10 August 2008, Sunday Times
The Thief at the End of the World. Rubber, Power and the Seeds of Empire by Joe Jackson
http://entertainment.timesonline.co.uk/tol/arts_and_entertainment/books/non-fiction/article4486584.ece

30 May 2008, Times Literary Supplement
Fruits and Plains: The Horticultural Transformation of America by Philip J. Pauly
http://entertainment.timesonline.co.uk/tol/arts_and_entertainment/the_tls/article4034273.ece

17 May 2008, The Guardian
The Morville Hours: The Story of a Garden by Katherine Swift
<http://books.guardian.co.uk/review/story/0,,2280546,00.html>

13 March 2008, Times Literary Supplement
The Faber Book of Gardens edited by Philip Robinson

February 2008, House & Garden
Beachcombing: The Narrative of Trees by Richard Mabey

22 December 2007, The Guardian
The Head Gardeners: Forgotten Heroes of Horticulture by Toby Musgrave
<http://books.guardian.co.uk/departments/history/story/0,,2231181,00.html>

8 December 2007, The Guardian
My Dearest Friend: Letters of Abigail and John Adams, edited by Margaret A. Hogan and C. James Taylor
<http://books.guardian.co.uk/reviews/history/0,,2223854,00.html>

13 September 2007, Times Literary Supplement
From A to BIBA. The Autobiography of Barbara Hulanicki

September 2007, Notes and Records of the Royal Society, Vol. 67:2, 2007
Joseph Banks and the British Museum: the world of collecting, 1770-1830 by Neil Chambers

25 August 2007, The Guardian
The Scientific Correspondence of Sir Joseph Banks, 1765-1820, edited by Neil Chambers
<http://books.guardian.co.uk/departments/scienceandnature/story/0,,2155612,00.html>

11 August 2007, The Guardian
Mrs Cook's Book of Recipes: For Mariners in Distant Seas by John Dunmore
<http://books.guardian.co.uk/review/story/0,,2146062,00.html>

12 July 2007, Times Literary Supplement
Choconut Chaos by Diana Souhami & Captain Bligh's Second Chance edited by Roy Schreiber

7 July 2007, The Guardian
Arcadian Friends: Inventing the English Landscape Garden by Tim Richardson
<http://books.guardian.co.uk/review/story/0,,2120357,00.html>

27 April 2007, Times Literary Supplement
The Dessau Wörlitz Garden Kingdom by Thomas Weiss

31 March 2007, The Guardian
No Place for Ladies. The Untold Story of Women in the Crimean War by Helen Rappaport &
Mrs Duberly's War. Journal & Letters from the Crimea, edited by Christine Kelly
<http://books.guardian.co.uk/reviews/history/0,,2046619,00.html>

3 March 2007, The Guardian
Virgins, Weeders and Queens. A History of Women in the Garden by Twigs Way
<http://books.guardian.co.uk/review/story/0,,2025094,00.html>

EXHIBIT C: REFERENCES

IPCC. 2014. Fifth Assessment Report of the Intergovernmental Panel on Climate Change.
<https://www.ipcc.ch/report/ar5/>.

Jefferson, T. 1781. Notes on the State of Virginia.
http://avalon.law.yale.edu/18th_century/jeffvir.asp.

Madison, J. 1818. Address to the Agricultural Society of Albemarle, 12 May 1818.
<https://founders.archives.gov/documents/Madison/04-01-02-0244> (Exhibit D).

Marsh, GP. 2003. Man and Nature: Or, Physical Geography as Modified by Human Action.
University of Washington Press, Seattle, WA.

von Humboldt, A. 1996. Personal Narrative of a Journey to the Equinoctial Regions of the New
Continent. Penguin Books, London, UK. David Lowenthal, ed.

von Humboldt, A. 1997. Cosmos: A Sketch of the Physical Description of the Universe. John
Hopkins University Press, Baltimore, MD.

von Humboldt, A. 2014. Views of Nature. University of Chicago Press, Chicago. Stephen T.
Jackson, ed.

Wulf, A. 2012. Founding Gardeners: The Revolutionary Generation, Nature, and the Shaping of
the American Nation. Vintage Books, New York, NY.

Wulf, A. 2016. The Invention of Nature: Alexander von Humboldt's New World. Vintake
Books, New York, NY.

EXHIBIT D: ADDRESS TO THE AGRICULTURAL SOCIETY OF ALBEMARLE**Founders Online****Address to the Agricultural Society of
Albemarle, 12 May 1818**

Address to the Agricultural Society of Albemarle

12 May 1818

It¹ having pleased the Society to name me for their presiding member, I feel it a duty, on my first appearing among you, to repeat my acknowledgements, for that honorary distinction; with the assurances of my sincere desire to promote the success of an establishment, which has in view so valuable an object as that of improving the agriculture of our country.

The faculty of cultivating the earth, and of rearing animals, by which food is increased beyond the spontaneous supplies of nature, belongs to man alone. No other terrestrial being has received a higher gift, than an instinct, like that of the Beaver or the Ant, which merely hoards, for future use, the food spontaneously furnished by nature.

As this peculiar faculty gives to man a pre-eminence over irrational animals; so, it is the use made of it by some, and the neglect of it by other communities, that distinguish them from each other, in the most important features of the human character.

The contrast between the enlightened and refined nations on some parts of the earth, and the rude and wretched tribes on others, has its foundation in this distinction. Civilization is never seen without agriculture: nor has agriculture ever prevailed, where the civilized arts did not make their appearance.

But, closely as agriculture and civilization are allied, they do not keep pace with each other. There is probably, a much higher state of agriculture in China and Japan,² than in many other countries far more advanced in the improvements of civilized life. It is surely no small reproach to the latter, that with so great a superiority in science, and in the fuller possession of the auxiliary arts, they should suffer themselves to be outstripped in the very art by which both are essentially distinguished from the brute creation.

It must not be inferred, however, from the capacities and the motives of man, for an artificial increase of the productions of the earth, that the transition from the hunter, or even the herdsman state, to the agricultural, is a matter of course. The first steps in this transition, are attended with difficulty; and what is more, with disinclination.

Without a knowledge of the metals, and the implements made of them, the process of opening and stirring the soil, is not an easy operation; tho' one perhaps, not requiring more effort and contrivance, than produced the instruments used by Savages in war and in the chase.

And that there is a disinclination in human nature to exchange the savage for the civilized life, cannot be questioned. We need not look for proofs beyond our own neighbourhood. The Indian Tribes have ever shewn an aversion to the change. Neither the persuasive examples of plenty and comfort derived from the culture of the earth by their white brethren, nor the lessons and specimens of tillage placed in the midst of them, and seconded by actual sufferings from a deficient and precarious subsistence, have diverted them from their strong propensities and habitual pursuits. In the same spirit, they always betray an anxious disposition to return to their pristine life, after being weaned from it by time, and apparently moulded by intellectual and

moral instruction, into the habits and tastes of an agricultural people. A still more conclusive evidence of the bias of human nature, is seen in the familiar fact, that our own people, nursed and reared in these habits and tastes, easily slide into those of the savage, and are rarely reclaimed to civilized society with their own consent.

Had the Europeans, on their arrival, found this continent destitute of human inhabitants, whose dangerous neighbourhood kept them in a compact and agricultural state, and had their communication with the countries they left, been discontinued, they might have spread themselves into the forests where game and fruits would have abounded; and gradually forgetting the arts no longer necessary to their immediate wants, have degenerated into savage tribes.

An admired historian,^{*} in his enquiry into the origin of the American Savages,³ represents any such degeneracy as impossible. He lays it down as a certain principle that the necessary arts of life, when once introduced among a people, can never be lost; that the dominion over inferior animals once enjoyed, will never be abandoned; and that America, consequently, must have been peopled from a country as uncivilized as itself. Yet,⁴ he derives the American Savages, generally, from the Tartars, whose example must have taught them the use of certain animals, for which a substitute might have been found in the Bison or Buffalo at least, (the same animal with the Cow,) if not in the Elk, the Moose, or the Caraboo: And he regards the Esquimaux, a tribe distinguished in several respects, for their rude condition, as descendants from the Greenlanders, (of the same modes of life with themselves,) who were a colony from Norway planted in the ninth century; an epoch prior to which the Norwegians had made such progress in the arts, as to be capable of formidable maritime expeditions. The Greenland Colony, therefore, must have undergone a degeneracy from the condition of its parent country. Without supposing the possibility of a transition from a better state of human society, to a savage state, how would the learned historian have accounted for the introduction of the savage state at all?⁵

The bent of human nature may be traced on the chart of our own country. The manufacturer readily exchanges the loom for the plough, in opposition often, to his own interest, as well as to that of his country. The cultivator, in situations presenting an option, prefers to the labours of the field, the more easy employment of rearing a herd. And as the game of the forest is approached, the hunting life displays the force of its attractions. Where do we behold a march in the opposite direction; the hunter becoming the herdsman; the latter a follower of the plough; and the last repairing to the manufactory or the workshop?⁶

Such indeed is the fascination of that personal independence which belongs to the uncivilized state, and such the disrelish and contempt of the monotonous labour of tillage, compared with the exciting occupations of the chace [*sic*], or with the indolence enjoyed by those who subsist chiefly on the mere bounties of nature, or on their migratory flocks, that a voluntary relinquishment of these latter modes of life, is little to be expected. We certainly perceive nothing in the character of our savage neighbours, from which it could be inferred that even the germs of agriculture observed in their spots of maize, and a few other cultivated plants, would ever be developed into the extent implied by an agricultural life. To that little resource combined with the game furnished by the forest and by the lake or the stream, their population and habits are adjusted. There may be said, in fact, to be a plenum of the former; because it is commensurate with their food; and this cannot be increased without a change of habits, which being founded in natural propensities, do not change of themselves.

The first introduction of agriculture among a savage people appears, accordingly, never to have taken place without some extraordinary interposition. Where it has not been obtruded by

colonies transplanted from agricultural countries, as from Phœnicia and Egypt into Greece, and from Greece herself, among her savage neighbours, the revolution has proceeded from some individual whose singular endowments, and supernatural pretensions, had given him an ascendancy for the purpose. All these great reformers, in ancient times, were regarded as more than men, and ultimately worshipped as gods. A very remarkable example of modern date, is found in the revolution from the savage to the agricultural state, said to have been brought about by Manco Capac,⁷ among the Peruvians, to whom he represented himself as the offspring of the sun.

Agriculture once effectually commenced, may proceed, of itself, under impulses of its own creation. The mouths fed by it increasing, and the supplies of nature decreasing, necessity becomes a spur to industry; which finds another spur, in the advantages incident to the acquisition of property in the civilized state. And thus a progressive agriculture, and a progressive population ensue.

But, although no determinate limit presents itself to the increase of food, and to a population commensurate with it, other than the limited productiveness of the earth itself, we can scarcely be warranted in supposing that all the productive powers of its surface can be made subservient to the use of man, in exclusion of all the plants and animals not entering into his stock of subsistence; that all the elements and combinations of elements in the earth, the atmosphere and the water, which now support such various and such numerous descriptions of created beings, animate and inanimate, could be withdrawn from that general destination, and appropriated to the exclusive support and increase of the human part of the creation; so that the whole habitable earth should be as full of people, as the spots most crowded now are or might be made, and as destitute as those spots, of the plants and animals not used by man.

The supposition cannot well be reconciled with that symmetry in the face of nature, which derives new beauty from every insight that can be gained into it. It is forbidden also, by the principles and laws which operate in various departments of her economy, falling within the scope of common observation, as well as within that of philosophic researches.

The earth contains not less than thirty or forty thousand kinds of plants; not less than six or seven hundred of birds; nor less than three or four hundred of quadrupeds; to say nothing of the thousand species of fishes. Of reptiles and insects, there are more than can be numbered. To all these must be added, the swarms and varieties of animalcules and minute vegetables not visible to the natural eye, but whose existence is probably connected with that of visible animals and plants.

On comparing this vast profusion and multiplicity of beings with the few grains and grasses, the few herbs and roots, and the few fowls and quadrupeds, which make up the short list adapted to the wants of man; it is difficult to believe that it lies with him, so to re-model the work of nature, as it would be re-modelled, by a destruction, not only of individuals, but of entire species; and not only of a few species, but of every species, with the very few exceptions which he might spare for his own accommodation.

Such a multiplication of the human race, at the expence of the rest of the organized creation, implies that the food of all plants is composed of elements equally and indiscriminately nourishing all; and which consequently may be wholly appropriated to the one or few plants best fitted for human use.

Whether the food or constituent matter of vegetables, be furnished from the earth, the air or water; and whether directly, or by either, through the medium of the others, no sufficient ground appears for the inference that the food for all is the same.

Different plants require different soils; some flourishing in sandy, some in clayey; some in moist, some in dry soils; some in warm, some in cold situations. Many grow only in water—and a few subsist in the atmosphere. The forms, the textures and the qualities of plants are still more diversified. That things so various and dissimilar in their organizations, their constitutions and their characters, should be wholly nourished by, and consist of precisely the same elements, requires more proof than has yet been offered.⁸

A case which has been relied on to prove that different foods are not necessary for different plants, is that of grafting or inoculating one kind of plant on another kind; the sap obtained by the stock for itself, being found to feed and perfect the graft. But, this operation has its limits. It does not extend beyond plants having a certain affinity. The Apple Tree may be planted on the Pear or the Quince. It will not succeed on the Peach or the Cherry. If the cases prove that the same food suffices for the Apple and the Pear, they equally prove that different foods are required for the Apple and the Peach. It is said even, that the fruit from the Peach Graft on the Almond, is not precisely the same with that from a Peach Graft on a Plum.

It may be offered as another argument to the same effect, that all animal and vegetable decompositions answer indiscriminately as manures. The fact is not precisely so. Certain manures succeed best with certain plants.⁹ It is true, nevertheless, that animal and vegetable substances in a decomposed state, are, generally, manures for plants. Fish even, an animal from the water, is successfully used as a manure for Indian Corn and other crops. But this, and similar examples prove only, that some ingredients are the same in all animals and plants, not that all the ingredients in each are the same.

The chemist, though as yet a fellow student as much as a preceptor of the agriculturist, justly claims attention to the result of his processes. From that source we learn that the number of known elements, not yet decomposable, is between forty and fifty; that about seven or eight belong to the organs of plants; that different elements enter into the composition of the same plant; and that they are combined in different numbers and in different proportions, in different plants.¹⁰ Supposing then, as must be supposed, that these different elements, in their actual quantities and proportions, are adapted to the quantities and the proportions of the existing varieties of plants; it would happen in so great a change as that in question, with respect to the number and variety of plants, that the quantities and the proportions of the elements, would not be adapted to the particular kinds and numbers of plants retained by man for his own use. Like the types of the Alphabet, apportioned to the words composing a particular book, when applied to another book materially different in its contents, there would be, of some a deficiency, of others, a useless surplus.

Were it less difficult to admit that all the sources of productiveness could be exclusively appropriated to the food of man, is it certain that an obstacle to his indefinite multiplication would not be encountered in one of the relations between the atmosphere and organized beings?

Animals, including man, and plants may be regarded as the most important part of the terrestrial creation. They are pre-eminent in their attributes; and all nature teems with their varieties and their multitudes, visible and invisible. To all of them, the atmosphere is the breath of life. Deprived of it, they all equally perish. But it answers this purpose by virtue of its appropriate constitution and character. What are these?

The atmosphere is not a simple but a compound body. In its least compound state, it is understood to contain, besides what is called vital air, others noxious in themselves, yet without a portion of which, the vital air becomes noxious. But the atmosphere in its natural state, and in its ordinary communication with the organized world, comprises various ingredients or

modifications of ingredients derived from the use made of it, by the existing variety of animals and plants. The exhalations & perspirations, the effluvia and transpirations¹¹ of these, are continually charging the atmosphere with a heterogeneous variety and immense quantity of matter, which together must contribute to the character which fits it for its destined purpose, of supporting the life and health of organized beings. Is it unreasonable to suppose, that if, instead of the actual composition and character of the animal and vegetable creation, to which the atmosphere is now accommodated, such a composition and character of that creation, were substituted, as would result from a reduction of the whole to man and a few kinds of animals and plants; is the supposition unreasonable, that the change might essentially affect the aptitude of the atmosphere for the functions required of it; and that so great an innovation might be found, in this respect, not to accord with the order and economy of nature?

The relation of the animal part and the vegetable part of the creation to each other, through the medium of the atmosphere, comes in aid of the reflection suggested by the general relation between the atmosphere and both. It seems to be now well understood, that the atmosphere when respired by animals becomes unfitted for their further use, and fitted for the absorption of vegetables; and that when evolved by the latter, it is refitted for the respiration of the former: an interchange being thus kept up, by which this breath of life is received by each, in a wholesome state, in return for it in an unwholesome one.

May it not be concluded from this admirable arrangement and beautiful feature in the economy of nature, that if the whole class of animals were extinguished, the use of the atmosphere by the vegetable class alone, would exhaust it of its life-supporting power; that in like manner, if the whole class of vegetables were extinguished, the use of it by the animal class alone, would deprive it of its fitness for their support? And if such would be the effect of an entire destruction of either class, in relation to the other, the inference seems to press itself upon us, that so vast a change in the proportions of each class to the other, and in the species composing the respective classes, as that in question, might not be compatible with the continued existence and health of the remaining species of the two classes.

The¹² immensity of the atmosphere, compared with the mass of animals and vegetables, forms an apparent objection only to this view of the subject. The comparison could at most suggest questions as to the period of time necessary to exhaust the atmosphere of its unrenewed capacity to keep alive animal or vegetable nature, when deprived, either, of the support of the other. And this period contracts itself at once to the imagination, when it is recollected that the immensity of the atmosphere is the effect of its elasticity and rarefaction. We know from the barometer, that condensed to the specific gravity of Mercury, its rise above the surface of the earth would be but about thirty inches; and from the well pump, that condensed to the specific gravity only of water, which is nearly the same with that of the human body, its rise would be little more than as many feet; that is, a little more than five times the human stature. It is found that a single human person employs in respiration not less than sixteen or eighteen times his own weight of common air, in every twenty-four hours. In different degrees, some greater, some less, the case is the same with most other animals. Plants make a correspondent use of air for their purposes.

Other views of the economy of nature coincide with the preceding. There is a known tendency in all organized beings to multiply beyond the degree necessary to keep up their actual numbers. It is a wise provision of nature—1, to guard against the failure of the species: 2, to afford in the surplus, a food for animals whether subsisting on vegetables, or on other animals which subsist on vegetables. Nature has been equally provident in guarding against an excessive

multiplication of any one species which might too far encroach on others, by subjecting each, when unduly multiplying itself, to be arrested in its progress by the effect of the multiplication—1, in producing a deficiency of food; and where that may not happen, 2, in producing a state of the atmosphere unfavourable to life and health. All animals, as well as plants, sicken and die in a state too much crowded. It is the case with our domestic animals of every sort, where no scarcity for food can be the cause.¹³ To the same laws mankind are equally subject. An increase, not consisting with the general plan of nature, arrests itself. According to the degree in which the number thrown together exceeds the due proportion of space and air, disease and mortality ensue. It was the vitiated air alone which put out human life in the crowded hole of Calcutta.¹⁴ In a space somewhat enlarged, the effect would have been slower, but not less certain. In all confined situations, from the dungeon, to the crowded workhouses, and from these, to the compact population of overgrown cities, the atmosphere becomes in corresponding degrees, unfitted by re-iterated use, for sustaining human life and health. Were the atmosphere breathed in cities and not diluted and displaced by fresh supplies from the surrounding country, the mortality would soon become general. Were the surrounding country thickly peopled and not refreshed in like manner, the decay of health, though a later, would be a necessary consequence. And were the whole habitable earth covered with a dense population,¹⁵ wasteful maladies might be looked for, that would thin the numbers into a healthy proportion.

Were the earth in every productive spot, and in every spot capable of being made productive, appropriated to the food of man; were the spade substituted for the plough, and all animals consuming the food of man, or food for which human food might be substituted, banished from existence, so as to produce the maximum of population on the earth, there would be more than an hundred individuals, for every one now upon it.¹⁶ In the actual population of many countries, it brings on occasional epidemics to be traced to no other origin than the state of the atmosphere. Increase the numbers to ten or twenty fold,¹⁷ and can it be supposed that they would, at any time, find the breath of life in a condition to support it; or if that supposition be admissible when limited to a single country, can it be admitted, when not only the contiguous countries, but the whole earth was equally crowded?

Must we then adopt the opinion entertained by some philosophers, that no variation whatever in the numbers and proportions of the organized beings belonging to our globe, is permitted by the system of nature; that the number of species and of individuals in the animal and vegetable empires, since they attained a destined complement, has been, and must always be the same; that the only change possible is in local augmentations and diminutions which balance each other, and thus maintain the established and unalterable order of things?

This would be the opposite extreme to that which has been rejected. Man, though so similar in his physical constitution to many other animals, is essentially distinguished from all other organized beings, by the intellectual and moral powers with which he is endowed. He possesses a reason and a will by which he can act on matter organized and unorganized. He can, by the exercise of these peculiar powers, increase his subsistence, by which his numbers may be increased beyond the spontaneous supplies of nature; and it would be a reasonable conclusion, that making as he does, in his capacity of an intelligent and voluntary agent, an integral part of the terrestrial system, the other parts of the system are so framed as not to be altogether unsusceptible of his agency, and unliable to its effects.

This reasonable conclusion is confirmed by the fact, that the capacity of man, derived from his reason and his will, has effected an increase of particular plants and animals conducive to an

increase of his own race; and a diminution of the numbers, if not of the species, of plants and animals displaced by that increase.

Most, if not all of our domesticated animals probably exceed the numbers which, without the intervention of man, would be their natural amount; whilst the animals preying on, or interfering with them, are proportionally reduced in their numbers.

The case is the same with cultivated plants. They are increased beyond their natural amount; and banish, or proportionally reduce such as interfere with them.

Nor can it be said, that these changes made by human art and industry in some regions, are balanced by corresponding changes made by nature, in other regions. Take for examples, the articles of wheat, rice, millet, and maize, which are the chief food of civilized man; and which are now spread over such immense spaces. It is not possible to regard them as occupying no more than their original and fixed proportions of the earth; and that in other parts of it, they have disappeared in the same degree in which they are thus artificially extended. These grains belong to the torrid and temperate zones only; and so great a proportion of these zones have been explored, that it is certain, they could not have been displaced from other parts of the globe, in the degree in which they abound where they are now cultivated, and where it is certain they owe their abundance to cultivation. There must consequently be an absolute increase of them produced by the agency of man.

Take more particularly for an example, the article of rice, which constitutes so large a portion of human food. The latitudes to which its growth is limited by the nature of the plant, are for the most part so well known, that it may be assumed for an unquestioned fact, that this grain cannot always have prevailed any where, in the extent in which it is now cultivated. And it is equally certain, that the vegetable productions belonging to the same climates, which must have been displaced by its cultivation, have not received an equivalent introduction and extension elsewhere.

It is remarkable that the vegetable productions most extensively used as human food, are but little, if at all found in their indigenous state; whether that state be the same as their present one, or a state from which they were improveable into their present state. They seem indeed not likely to flourish extensively in situations not prepared by the hand of man. The potato so recently brought into use, and now spreading itself over so great a surface, can barely be traced to a native state in the mountains of Chili,¹⁸ nor can it be believed, that previous to its adoption by man, it ever existed in the extent to which cultivation is now carrying it.

These views of the subject seem to authorise the conclusion, that although there is a proportion between the animal and vegetable classes of beings on our globe, and between the species in each class, with respect to which, nature does not permit such a change as would result from a destruction of the animals and vegetables not used by man; and a multiplication of the human race, and of the several species of animals and vegetables used by it, sufficient to fill up the void; yet that there is a degree of change which the peculiar faculties of man enable him to make; and by making which, his fund of subsistence and his numbers may be augmented; there being at the same time, whenever his numbers, and the change, exceed the admitted degree, a tendency in that excess to correct itself.

Could it however be supposed that the established system and symmetry of nature, required the number of human beings on the globe to be always the same; that the only change permitted in relation to them, was in their distribution over it; still, as the blessing of existence to that number would materially depend on the parts of the globe on which they may be thrown; on the degree in which their situation may be convenient or crowded; and on the nature of their political

and social institutions; motives would not be wanting to obtain for our portion of the earth, its fullest share, by improving the resources of human subsistence, according to the fair measure of its capacity. For, in what other portion of equal extent will be found climates more friendly to the health or congenial to the feelings of its inhabitants? In what other, a soil yielding more food with not more labour? And above all, where will be found institutions equally securing the blessings of personal independence, and of social enjoyments? The enviable condition of the people of the United States, is often too much ascribed to the physical advantages of their soil and climate, and to their uncrowded situation. Much is certainly due to these causes—but a just estimate of the happiness of our country, will never overlook what belongs to the fertile activity of a free people, and the benign influence of a responsible government.

In proportion as we relax the hypothesis which makes the aggregate number of mankind unsusceptible of change, and believe that the resources of our country may not only contribute to the greater happiness of a given number, but to the augmentation of the number enjoying a greater happiness, the motives become stronger for the improvement and extension of them.

But, whilst all are sensible that agriculture is the basis of population and prosperity, it cannot be denied that the study and practice of its true principles have hitherto been too generally neglected in the United States; and that this state has at least its full share of the blame. Now only for the first time, notwithstanding several meritorious examples of earlier date, a general attention seems to be awakened to the necessity of a reform. Patriotic societies, the best agents for effecting it, are pursuing the object with the animation and intelligence which characterize the efforts of a self-governed people, whatever be the objects to which they may be directed.

Among these promising institutions, I cannot glance at the names of those composing that of Albemarle, without being assured, that its full quota of information will be furnished to the general stock. I regret only, that my own competency bears so little proportion to my wishes to cooperate with them. That I may not be thought, however deficient in good will, as well as in other requisites, I shall venture on the task, a task the least difficult, of pointing out some of the most prevalent errors in our husbandry, and which appear to be among those which may merit the attention of the society, and the instructive examples of its members.¹⁹

I. The error first to be noticed is that of cultivating land, either naturally poor or impoverished by cultivation. This error, like many others, is the effect of habit, continued after the reason for it has failed. Whilst there was an abundance of fresh and fertile soil, it was the interest of the cultivator to spread his labour over as great a surface as he could. Land being cheap and labour dear, and the land co-operating powerfully with the labour, it was profitable to draw as much as possible from the land. Labour is now comparatively cheaper and land dearer. Where labour has risen in price fourfold, land has risen tenfold. It might be profitable, therefore, now to contract the surface over which labour is spread, even if the soil retained its freshness and fertility. But this is not the case. Much of the fertile soils is exhausted, and unfertile soils are brought into cultivation; and both co-operating less with labour in producing the crop, it is necessary to consider how far labour can be profitably exerted on them; whether it ought not to be applied towards making them fertile rather than in further impoverishing them; or whether it might not be more profitably applied to mechanical occupations or to domestic manufactures.

In the old countries of Europe, where labour is cheap and land dear, the object is to augment labour and contract the space on which it is employed. In the new settlements taking place in this country, the original practice here may be rationally pursued. In the old settlements, the reason for the practice in Europe is becoming daily less inapplicable, and we ought to yield to the change of circumstances by forbearing to waste our labour on land, which, besides not paying for

it, is still more impoverished and rendered more difficult to be made rich. The crop which is of least amount gives the blow most mortal to the soil. It has not been a very rare thing to see land under the plough not producing enough to feed the ploughman and his horse; and it is in such cases that the death blow is given. The goose is killed without even obtaining the coveted egg.

There cannot be a more rational principle in the code of agriculture, than that every farm which is in good heart should be kept so; that every one not in good heart should be made so; and that what is right as to the farm generally, is so as to every part of every farm. Any system therefore, or want of system, which tends to make a rich farm poor, or does not tend to make a poor farm rich, cannot be good for the owner, whatever it may be for the tenant or superintendant who has a transient interest only in it. The profit, where there is any, will not balance the loss of intrinsic value sustained by the land.

II. The evil of pressing too hard on the land, has also been much increased by the bad mode of ploughing it. Shallow ploughing, and ploughing up and down hilly land have, by exposing the loosened soil to be carried off by rains, hastened more than any thing else, the waste of its fertility. When the mere surface is pulverized, moderate rains on land but little uneven, if ploughed up and down, gradually wear it away. And heavy rains on hilly land ploughed in that manner, soon produce a like effect, notwithstanding the improved practice of deeper ploughing. How have the beauty and value of this red ridge of country suffered from this cause? and how much is due to the happy improvement introduced by a member of this Society, whom I need not name,* by a cultivation in horizontal drills, with a plough adapted to it? Had the practice prevailed from the first settlement of the country, the general fertility would have been more than the double of what the red hills, and indeed all other hilly lands now possess; and the scars and sores now defacing them would no where be seen. Happily, experience is proving that this remedy aided by a more rational management in other respects, is adequate to the purpose of healing what has been wounded, as well as of preserving the health of what has escaped the calamity. It is truly gratifying to observe how fast the improvement is spreading from the parent example. The value of our red hills, under a mode of cultivation which guards their fertility against wasting rains, is probably exceeded by that of no uplands whatever; and without that advantage, they are exceeded in value by almost all others. They are little more than a lease for years.

Besides the inestimable advantage from horizontal ploughing, in protecting the soil against the wasting effect of rains, there is a greater one, in its preventing the rains themselves from being lost to the crop. The Indian Corn is the crop which most exposes the soil to be carried off by the rains, and it is at the same time the crop which most needs them. Where the land is not only hilly, but the soil thirsty, (as is the case particularly throughout this mountainous range) the preservation of the rain as it falls, between the drilled ridges, is of peculiar importance; and its gradual settling downwards to the roots, is the best possible mode of supplying them with moisture. In the old method of ploughing shallow, with the furrows up and down, the rain, as well as the soil, was lost.

III. The neglect of manures is another error which claims particular notice. It may be traced to the same cause with our excessive cropping. In the early stages of our agriculture, it was more convenient and more profitable to bring new land into cultivation, than to improve exhausted land. The failure of new land, has long called for the improvement of old land; but habit has kept us deaf to the call.

Nothing is more certain than that continual cropping without manure deprives the soil of its fertility. It is equally certain, that fertility may be preserved or restored, by giving to the earth

animal or vegetable manure equivalent to the matter taken from it; and that a perpetual fertility is not, in itself, incompatible, with an uninterrupted succession of crops. The Chinese, it is said, smile at the idea that land needs rest, as if, like animals, it had a sense of fatigue. Their soil does not need rest, because an industrious use is made of every fertilizing particle, that can contribute towards replacing what has been drawn from it. And this is the more practicable with them, as almost the whole of what is grown on their farms is consumed within them. That a restoration to the earth of all that annually grows on it, prevents its impoverishment, is sufficiently seen in our forests; where the annual exuviae of the trees and plants, replace the fertility of which they deprive the earth. Where frequent fires destroy the leaves and whatever else is annually dropped on the earth, it is well known that the land becomes poorer; this destruction of the natural crop having the same impoverishing effect as the removal of a cultivated crop. A still stronger proof that an annual restoration to the earth of all its annual product will perpetuate its productiveness, is seen where our fields are left uncultivated and unpastured. In this case, the soil, receiving from the decay of the spontaneous weeds and grasses, more fertility than they extract from it, is, for a time at least, improved, not impoverished. Its improvement may be explained, by the fertilizing matter which the weeds and grasses derive from water and the atmosphere, which forms a nett gain to the earth. At what point, or from what cause, the formation and accumulation of vegetable mould from this gain ceases, is not perhaps, very easy to be explained. That it does cease, is proved by the stationary condition of the surface of the earth in old forests; and that the amount of the accumulation varies with the nature of the subjacent earth, is equally certain. It seems to depend also on the species of trees and plants which happen to contribute the materials for the vegetable mould.

But, the most eligible mode of preserving the richness, and of enriching the poverty of a farm is, certainly that of applying to the soil a sufficiency of animal and vegetable matter in a putrified state, or a state ready for putrefaction, in order to procure which, too much care cannot be observed in saving every material furnished by the farm. This resource was among the earliest discoveries of men living by agriculture; and a proper use of it has been made a test of good husbandry in all countries, ancient and modern, where its principles and profits have been studied.

Some farmers of distinction, headed by Tull,²⁰ supposed that mere earth, in a pulverized state, was sufficient without manure for the growth of plants; and consequently, that continued pulverization would render the soil perpetually productive; a theory, which never would have occurred to a planter of tobacco or of Indian corn, who finds the soil annually producing less and less, under a constant pulverizing course. The known experiment of Van-Helmont²¹ seemed to favour the opposite theory, that the earth parted with nothing towards the plants growing on it. If there were no illusion in the case, the earth used by him must, at least, have been destitute of vegetable mould. For, in an experiment by Woodhouse,²² a garden mould was diminished in its weight by a plant which grew in it. And the latest chemical examination of the subject co-incide with the general opinion of practical husbandmen that the substance of plants, partakes of the substance of the soil.

The idea is, indeed, very natural that vegetable matter which springs from the earth, and of itself returns to the earth, should be one source at least of the earth's capacity to re-produce vegetable matter.

It has been asked how it happens that Egypt and Sicily, which have for ages been exporting their agricultural produce without a return of any equivalent produce, have not lost their re-productive capacity. One answer has been, that they have lost no small degree of it. If the fact be

otherwise with regard to Egypt, it might be accounted for by the fertilizing inundations of the Nile. With regard to Sicily, there may be something in the system of husbandry, or some particular local circumstances, which countervail the continued asportation of the fruits of the soil. But it is far more probable, that the island is less productive than it once was. It is certainly less of a granary for other countries now, than it was when it received that title from the ancient Romans. And its population being diminished, the internal consumption must also be diminished. If a single farm is rendered less productive by a continued removal of its crops, without any adequate returns, no reason occurs why it should not happen to a number of farms multiplied to the extent of a whole country.

And that individual farms do lose their fertility in proportion as crops are taken from them, and returns of manure neglected, is a fact not likely to be questioned.

If it were, Virginia, unfortunately, is but too capable of furnishing the proofs. Her prevailing crops have been very exhausting, and the use of manures has been particularly neglected.

Tobacco and Indian Corn, which for a long time on the east side of the Blue Mountains were the articles almost exclusively cultivated, and which continue to be cultivated, the former extensively, the latter universally, are known to be great impoverishers of the soil. Wheat, which has for a number of years, formed a large portion of the general crop, is also an exhausting crop. So are Rye and Oats which enter occasionally into our farming system.

With so many consumers of the fertility of the earth, and so little attention to the means of repairing their ravages, no one can be surprised at the impoverished face of the country; whilst every one ought to be desirous of aiding in the work of reformation.

The first and main step towards it, is, to make the thieves restore as much as possible of the stolen fertility. On this, with other improvements which may be made in our husbandry, we must depend for the rescue of our farms from their present degraded condition.

Of Tobacco, not a great deal more than one half of the entire plant is carried to market. The residue is an item on the list of manures: and it is known to be in its quality a very rich one. The crop of Tobacco, however, though of great value, covers but a small proportion of our cultivated ground; and its offal can of course contribute but inconsiderably to the general stock of manure. It is probable also that what it does contribute, has been more carefully used as a manure, than any other article furnished by our crops.

The article which constitutes our principal manure is wheat straw. It is of much importance therefore to decide aright on the mode of using it. There are three modes: 1. Carrying it from the farm yard, after having passed through or being trodden and enriched by cattle. In that mode, the greater part of it must be used, if used at all; the straw going through that process, being a necessary part of the food allotted to the cattle. To derive the full advantage from it, it ought to be hauled out before the substance has been wasted by rain, by the sun, and by wind; and to be buried in the earth as soon after as possible. 2. Spreading the straw on the surface of the ground. Many respectable farmers are attached to this mode, as protecting the soil from the sun; and by keeping it moist, favoring the vegetation underneath, whether spontaneous or artificial; whilst the straw itself is gradually decomposed into a manure. The objection to this mode is the loss by evaporation, before this last effect is obtained. 3. Turning the straw at once under the surface of the earth. This would seem to be the best mode of managing manures generally; least of their substance being then lost. When the grain is trodden out from the straw, it is left in a state easily admitting this operation. Some difficulty may attend it, when the grain is threshed from the straw by the flail, or by the machines now in use, neither of which break the straw sufficiently to pieces.

It may be remarked with regard to this article of manure—1. That its weight is barely more than that of the grain. 2. That the grain is the part which makes the greatest draft on the fertility of the earth. 3. That the grain is for the most part not consumed within the farm. It is found on trial that a stalk of wheat, as generally cut, including the chaff, and the grains borne by the stalk, are pretty nearly of equal weight. The case is probably the same with rye; and not very different with oats. The proportion of fertilizing matter in the straw, to that in the grain, has not, as far as I know, been brought to any satisfactory test. It is doubtless much less in the straw, which alone in the case of wheat, is with us returnable in any form to the earth. This consideration, whilst it urges us to make the most of the article as a manure, warns us of its insufficiency.

The stubble and the roots of the small grains, not being taken from the earth, may be regarded as relapsing into a fertility equal to that of which they deprived the earth. This remark is applicable to all cultivated plants, the roots of which are not an esculent part.

An eminent citizen and celebrated agriculturist* of this state, has among other instructive lessons, called the public attention to the value of the corn stalk as a manure.²³ I am persuaded that he has not overrated it—And it is a subject of agreeable reflection, that an article which is so extensively cultivated as that of Indian corn, and which is so particularly exhausting, should be the one so capable of repairing the injury it does.

The corn stalk as a fodder is of great value. Not only the leaves, but the husk inclosing the ear, and the cob inclosed by it, are all more or less valuable food when duly preserved and dealt out to cattle. There is no better fodder than the leaves or blades for horses and oxen; nor any so much approved for sheep. The husk or shuck is a highly nourishing food for neat cattle. And the pickings of the stalk, even at a late season, and after much exposure to the weather, support them better than any of the straws. From the saccharine matter in the stalk, which is long retained about the joints, it cannot be doubted that if cut early, or before exposure to the weather, into parts small enough for mastication, it would well repay, as a food for cattle, the labor required for it.

The great value of the corn stalk, in all its parts as a fodder, was brought into full proof, by the use made of it during the late general failure of crops. It is to be hoped that the lesson will not be suffered to pass into oblivion.

But it is as a resource for re-fertilizing the soil, that the corn stalk finds the proper place here; and as such it merits particular notice; whether it be passed through animals; or be prepared by fermentation in the farm yard; or be merely spread on the surface of the earth, the mode in which its effect must be least considerable. The same qualities which render every part of it nutritious to animals, render it nutritious to the earth, and it is accompanied with the peculiar advantages: 1, that the grain itself is mostly every where, and altogether, in places distant from navigation, consumed within the farms producing it; 2, that as the grain is in greater proportion to the space on which it grows, than most other grains, so the rest of the plant is in greater proportion to the grain, than the rest of any other grain plant. The straw and chaff of the smaller grains, as already remarked, is in weight but about one half the grain. The corn stalk with all its appurtenant offal is of not less than three times, and if taken early from the field, probably of not less than four or five times the weight of the grain belonging to it. 3, the fertilizing matter contained in the corn stalk is greater, in proportion to its weight, than that contained in the straw and offal of other grains is to the weight of the straw and offal.

Would it be hazarding too much to say, that where a level surface, or the mode of cultivating a hilly one, prevents the rains from carrying off the soil, a restoration of an entire crop of Indian corn, in the form of manure, to the space producing it (there being no other intervening crop not

so restored) would replace the fertility consumed by the crop; and maintain a perpetual productiveness? Reason, the case of forest and fallow fields, where the spontaneous crop falls back of itself, to the earth, and the Chinese example, where the cultivated crop is restored to the earth, all pronounce that such would be the effect. And yet the fact stares us in the face, that our most impoverished fields, even the most level of them, owe their condition more to the crops of Indian corn, than to any other crops.

The articles of fodder which are least neglected as a fund of manure, are timothy and clover hays. But the average quantities on farms, is not as yet, very great; and seldom yield more than stable manure for gardens and culinary crops.

The cotton plant, which is so extensive a crop, in the more southern, and the South-Western States, is but little cultivated in Virginia, and scarcely at all in this part of it. I am not able to say how far it is comparatively an exhausting crop. But it would seem to be more capable than any crop, not wholly consumed within the farm, of preserving its fertility. The only part of the plant carried away is the cotton fibre or wooly part which bears an inconsiderable proportion to the other parts in weight, and as may be inferred, in fertilizing matter also. The seed alone, passing by the ball and the haulm, is of three times its weight, and contains the chief part of the oil in the plant. In the countries where cotton makes the principal part of the crop, the superfluous seed must deserve great attention as a manure. Where the fields are level or cultivated in horizontal drills, it might go far towards supporting a continued cropping without a diminished fertility.

The sum of these remarks on cultivating poor land, and neglecting the means of keeping or making land rich, is, that if every thing grown on a soil is carried from it, it must become unproductive; that if every thing grown on it be directly or indirectly restored to it, it would not cease to be productive; and, consequently, that according to the degree in which the one or the other practice takes place, a farm must be impoverished, or be permanently productive and profitable. Every acre made by an improved management to produce as much as two acres, is in effect, the addition of a new acre; with the great advantages, of contracting the space to be cultivated; and of shortening the distance of transportation between the fields, and the barn or the farm yard. One of the Roman writers,^{*} on husbandry,²⁴ enforces the obligation to an improving management by a story of one Paridius who had two daughters and a vineyard: When the elder was married, he gave her a third part of the vineyard; notwithstanding which, he obtained from two thirds, the same crop as from the whole: when his other daughter was married, he portioned her with the half of what remained; and still, the produce of his vineyard was undiminished. The story, short as it is, contains a volume of instruction.

The plaster or gypsum, though not a manure within the farm itself, has been too long neglected as a fertilizing resource. It is now beginning to take a high and just rank as such. The proofs of its efficacy are as incontestible as the causes of it are obscure. The experiments of a very distinguished chemist,[†] led him to the opinion, that its substance enters into the substance of the plant.²⁵ Without doubting the fact, it does not sufficiently account for the addition made to the size and weight of the plant, which greatly exceed the quantity of the plaster. It must, therefore, have some further mode of operating. Whether it be by neutralizing some noxious ingredient in the earth, one of the modes by which lime is supposed to operate, or by attracting and conveying to the plant, food from the earth, the air or water; or by exciting the plant to a more active use of its feeding powers, whatever they be; or by its accretion and assimilation to particular parts of plants on which these powers depend; thereby augmenting and strengthening those particular parts, and enabling the feeding powers to give proportional augmentation to every other part; whether by any one or more of these processes, or by some other or others

distinct from them all, the growth of plants be promoted by this mineral, remains, it would seem, to be yet explained. In the mean time, a more extensive use of it, promises much advantage to our agriculture. I take it, however, that this advantage cannot be permanent without making the increased product of the soil, a source of manure to the soil. That the effect of the plaster will be continued indefinitely, under a constant removal of the whole crop from the soil, surpasses belief. It can scarcely fail to exhaust at length, the productive powers of the earth. The period of time necessary for the purpose, may be uncertain; but that, as in the case of the other mineral manures, lime and marle, such must sooner or later, be the result, cannot well be so. The effect of pulverising the earth by tillage, as practised by Tull, is stated to have been uninterrupted crops of wheat, without manure for more than twenty years; which was regarded as a demonstration that tillage was a complete substitute for manure. Supposing the statement to be free from error, the inference is certainly not warranted by the fact. We know that some of our soils, not naturally richer than the highly manured soils on which Tull probably commenced his tillage, will bear a succession of crops for an equal period; and we know as well, that their fertility will not hold out forever. How long plaster, whatever be its mode of operation, will hold out, may not yet have been fully tried. But, to make it permanently successful, it will be wise to take for granted, that it must be made a source of future manure, as well as of immediate productiveness. If the crop, as augmented by the plaster, be given back to the soil, the soil may be benefitted more than it would be, by the return of a crop not augmented by the plaster. And in this way, fertility may be accelerated. The restoration of a crop increased by ordinary cultivation, to the soil on which it grew, would, I presume, fertilize it more than the restoration of a smaller crop spontaneously produced; although, in both cases, the whole taken from the soil, would return to it.

IV. Among the means of aiding the productiveness of the soil, which have not received merited attention, is irrigation. In scarcely any country does this resource abound more than in the United States; nor is there any where there is so little sensibility to its value. The inconsiderable use made of it is chiefly by emigrants, particularly Germans, or the immediate descendants of them. I have understood that the market of Baltimore has been much benefitted in dry seasons by the irrigation introduced by exiles from St. Domingo. For a distinguished proof of the importance of the practice, I may refer to the fact which has been stated, that in the neighbourhood of Barcelona in Spain, where a part of the land is under irrigation, and a part is not susceptible of it, both being otherwise of equal fertility, the part irrigated is of double price in the market. It is to be noted indeed that the climate is a dry one, and that the article cultivated is Lucerne. But this is a plant, which though much aided in its growth by moisture, is at the same time remarkable for the length of a tap-root, and fitted by that, as well as by the absorbent quality of its leaves, to flourish in a thirsty soil, and warm climate. Our particular district of country, abounding in springs, small streams, and suitable declivities, admits greatly of irrigation; and being generally of a thirsty nature, the more strongly invites the use of it.

V. I cannot but consider it as an error in our husbandry, that oxen are too little used in place of horses.

Every fair comparison of the expence of the two animals, favors a preference of the ox. But, the circumstance particularly recommending him is, that he can be supported when at work by grass and hay; whilst the horse requires grain, and much of it; and the grain generally given him is Indian corn, the crop which requires most labour and greatly exhausts the land.

From the best estimate I have been enabled to form, more than one half of the corn crop is consumed by horses, including the ungrown ones; and not less than one half, by other than pleasure horses. By getting free from this consumption, one half the labour and of the wear of the

land would be saved, or rather more than one half; for on most farms, one half of the crop of corn grows on not more than two-fifths, and sometimes a smaller proportion of the cultivated fields; and the more fertile fields would of course be retained for cultivation. Every one can figure to himself the ease and conveniency of a revolution which would so much reduce the extent of his cornfields; and substitute for the labour bestowed on them, the more easy task of providing pasturage and hay.

But will not the ox himself when kept at labour require grain food as well as the horse? Certainly much less, if any. Judging from my own observation, I should say, that a plenty of good grass or good hay, will suffice without grain, where the labour is neither constant nor severe. But I feel entire confidence in saying, that a double set of oxen alternately at work, and therefore half the time at rest, might be kept in good plight without other food than a plenty of good grass or good hay. And as this double set would double the supply of beef tallow and leather, a set off is found in that consideration for a double consumption of that kind of food.

The objections generally made to the ox are—1. That he is less tractable than the horse. 2. That he does not bear heat as well. 3. That he does not answer for the single plough used in our cornfields. 4. That he is slower in his movements. 5. That he is less fit for carrying the produce of the farm to market.

The first objection is certainly founded in mistake. Of the two animals, the ox is the more docile. In all countries where the ox is the ordinary draught animal, his docility is proverbial. His intractability, where it exists, has arisen from an occasional use of him only, with long and irregular intervals; during which, the habit of discipline being broken, a new one is to be formed.

The second objection has as little foundation. The constitution of the ox accommodates itself, as readily as that of the horse, to different climates. Not only in ancient Greece and Italy, but throughout Asia, as presented to us in ancient history, the ox and the plough are associated. At this day, in the warm parts of India and China, the ox, not the horse, is in the draught service. In every part of India, the ox always appears, even in the train of her armies. And in the hottest parts of the West-Indies, the ox is employed in hauling the weighty produce to the sea ports. The mistake here, as in the former case, has arisen from the effect of an occasional employment only, with no other than green food. The fermentation of this in the animal heated by the weather, and fretted by the discipline, will readily account for his sinking under his exertions; when green food even, much less dry, with a sober habit of labour would have no such tendency.

The third objection also, is not a solid one. The ox can, by a proper harness, be used singly as well as the horse, between the rows of Indian corn; and equally so used for other purposes. Experience may be safely appealed to on this point.

In the fourth place, it is alledged that he is slower in his movements. This is true; but in a less degree than is often taken for granted. Oxen that are well chosen for their form are not worked after the age of about eight years, (the age at which they are best fitted for beef,) are not worked too many together, and are suitably matched, may be kept to nearly as quick a step as the horse. May I not say, a step quicker than that of many of the horses we see at work, who, on account of their age or the leanness occasioned by the costliness of the food they require, lose that advantage where they might have once had it?

The last objection has most weight. The ox is not as well adapted as the horse to the road service, especially for long trips. In common roads, which are often soft, and sometimes suddenly become so, the form of his foot and the shortness of his leg, are disadvantages; and on roads frozen or turnpiked, the roughness of the surface in the former case, and its hardness in both cases, are inconvenient to his cloven hoof. But where the distance to market is not great,

where the varying state of the roads and of the weather, can be consulted; and where the road service is in less proportion to the farm service, the objection is almost deprived of its weight. In cases where it most applies, its weight is diminished by the consideration, that a much greater proportion of service on the farm may be done by oxen, than is now commonly done; and that the expence of shoeing them, is little different from that of keeping horses shod. It is observable that when oxen are worked on the farm, over rough frozen ground, they suffer so much from the want of shoes, however well fed they may be, that it is a proper subject for calculation, whether true economy does not require for them, that accommodation, even on the farm, as well as for the horses.

A more important calculation is, whether, in many situations, the general saving by substituting the ox for the horse would not balance the expence of hiring a carriage of the produce to market. In the same scale with the hire, is to be put the value of the grass and hay consumed by the oxen; and in the other scale, the value of the corn, amounting to one half of the crop, and of the grass and hay consumed by the horses. Where the market is not distant, the value of the corn saved, would certainly pay for the carriage of the market portion of the crop; and balance, moreover, any difference between the value of the grass and hay consumed by oxen, and the value of the oxen when slaughtered for beef. In all these calculations, it is doubtless proper not to lose sight of the rule, that farmers ought to avoid paying others for doing what they can do for themselves. But the rule has its exceptions; and the error, if it be committed, will not lie in departing from the rule, but in not selecting aright the cases which call for the departure. It may be remarked, that the rule ought to be more or less general, as there may, or may not be at hand, a market by which every produce of labour is convertible into money. In the old countries, this is much more the case, than in new; and in new, much more the case near towns, than at a distance from them. In this, as in most other parts of our country, a change of circumstances is taking place, which renders every thing raised on a farm more convertible into money than formerly; and as the change proceeds, it will be more and more a point for consideration, how far the labour in doing what might be bought, could earn more in another way, than the amount of the purchase. Still it will always be prudent, for reasons which every experienced farmer will understand, to lean to the side of doing, rather than hiring or buying what may be wanted.

The mule seems to be in point of economy, between the ox and the horse, preferable to the latter, inferior to the former, but so well adapted to particular services, that he may find a proper place on many farms. He is liable to the objection which weighs most against the ox. He is less fitted than the horse for road service.

VI. A more manifest error in the husbandry of the older settlements is that of keeping too many neat cattle on the farms. As a farm should not be cultivated farther than it can be continued in good heart; the stock of cattle should not be in greater number than the resources of food will keep in good plight. If a poor farm be unprofitable, so are poor cattle. It is particularly the case with the milch cows. When the whole of the food given them is necessary to support a lean existence, no part can be spared for the milk pail. The same food, given to the proper number, will not only keep them in a thrifty state, but enable them to supply the dairy. Even the manure from several poor cattle is worth less than that from a single fat one. The remark holds equally good with respect to the hide.

The misjudged practice in question, is another effect of inattention to the change of circumstances through which our country has passed. Originally the forest abounded in rich herbage which fed and fattened, without expence, all the cattle that could be brought through the winter into the spring. It was natural, at that time to keep as large a stock as could be preserved

through the winter. For a long time past, the forest is scarcely any where, a resource for more than two or three months; and in many places, no resource at all. A greater difficulty is often felt in finding summer, than winter subsistence. And yet, where no inclosed pasturage is provided to take the place of the extinct one in the forest, the habit, founded in reasons which have entirely ceased, is but too generally retained. The same number of cattle is aimed at, as if the forest was as ready to receive and fatten them now, as formerly. The size and appearance of our neat cattle, compared with those for which nature or good husbandry has provided sufficient food, are proofs that their food is not in proportion to their number; and that, where the food cannot be increased, the number ought to be reduced.

VII. Of all the errors in our rural economy, none is perhaps, so much to be regretted, because none so difficult to be repaired, as the injudicious and excessive destruction of timber and fire wood. It seems never to have occurred that the fund was not inexhaustible, and that a crop of trees could not be raised as quickly as one of wheat or corn.

Here again, we are presented with a proof of the continuance of the practice for which the reasons have ceased. When our ancestors arrived, they found the trees of the forest the great obstacle to their settlement, and cultivation. The great effort was of course to destroy the trees. It would seem that they contracted and transmitted an antipathy to them; for the trees were not even spared around the dwellings, where their shade would have been a comfort and their beauty an ornament; and it is of late years only, that these advantages have been attended to. In fact, such has been the inconsiderate and indiscriminate use of the axe, that this country is beginning to feel the calamity as much as some of the old countries of Europe; and it will soon be forced to understand the difficulty of curing it. A vast proportion of the farms on the eastern side of the Blue Ridge, and some even, on the other side, have but a scanty fund for present use, and are without a fund for permanent use. And to increase the evil, the remnant of timber and fuel on many farms, inadequate as it is, is left in situations remote from the dwelling, and incapable of being divided, according to the divisions and sub-divisions, into which all the larger farms must be rapidly forced by the law of descents, the impulses of parental affection, and other causes.

It is high time for many farmers, even in this quarter, and still more so in the country below us, to take this subject into serious consideration. Prudence will no longer delay to economize what remains of wood land; to foster the second growths where taking place in convenient spots; and to commence, when necessary, plantations of the trees recommended by their utility and quickness of growth.

I wish I could more satisfactorily estimate the proportion of wood land which ought to belong to every farm, as a permanent fund of timber for building and repairing houses; for fences, where live or stone ones may not have been introduced; for wheel carriages, and the other apparatus needed on farms. The estimate is the more difficult, because it must be varied according to many circumstances: particularly, according to the nature of the soil, and the kind of trees at once suited to it, and to the uses to be made of them.

Estimating the crop of wood yielded by an acre at twenty cords, the period of re-production at twenty years, and the average number of cords annually consumed at a fire place, including the culinary consumption, at ten cords; every fire place on a farm will require ten acres for a permanent supply of fuel. For the other necessities of the farm, several acres more ought to be added.

An estimate in a very sensible publication, entitled "The New England Farmer," makes seventeen acres necessary for a fire place.²⁶ The winters there are longer, and the climate may be

less favourable to the quick growth of trees. But their houses are generally closer than with us; to say nothing of a more judicious management than can be enforced on most of our farms.

To this catalogue of errors in our rural economy, considerable as it is, many, I fear, might be added. The task of pointing them out, I gladly leave to others, less incapable than I have shewn myself to be, by the very imperfect manner in which I have performed the one on which I ventured.

Printed copy (DLC: William C. Rives Papers); draft (NN). Draft 19 pp. Fragment; right half of last page is torn away; an unknown number of pages are missing. Copytext is taken from *An Address Delivered before the Agricultural Society of Albemarle, on Tuesday, May 12, 1818. By Mr. Madison, President of the Society* (Richmond, 1818; Shaw and Shoemaker 44668). Also printed as a series in issues 21–23 of the *Baltimore American Farmer* 1 (1819), 161–63, 169–71, 177–79, and in issues 1–4 of the *Albany, N.Y. Plough Boy* 1 (1819), 4–5, 12–13, 20–22, 27–28. First page of draft bears note in upper left corner in an unidentified hand: “‘Address, by Mr. Madison, late President of the United States, Delivered before the Albemarle, Va., Agricultural Society. May 12, 1818.’ Printed in: N.Y. Bd. of Agricultur. Memoirs, V. 1. (Albany, 1821); and also separately (1818).” Minor differences between the copytext and the draft have not been noted.

1. In the draft, JM noted in the top right margin of the first page: “See Encyclop. D A & D. [D’Alembert and Diderot] Foret, for facts showing succession of *different* trees &c instead of the same species occasioned by the failure of [...] Tom. 15. p. 9.”

2. In the draft, JM crossed out “& Japan.”

3. William Robertson, *The History of America* (2 vols.; London, 1777). JM owned a copy of a later edition of this work, entitled *The History of the Discovery and Conquest of America* (London, 1835).

4. At this point in the draft, JM wrote: “with an inconsistency not a little strange.”

5. In the draft JM wrote here then crossed out: “If it be not a degeneracy; it must be a distinct creation. If he could find the origin of the American savage, in a foreign people as savage as themselves, Where will he find the origin of the latter? He wd. at most have only obtained a tortoise for his elephant.”

6. In the draft JM wrote here and crossed out: “The remarks which have been applied to the hunting Tribes are applicable also to those subsisting chiefly on fruits and other spontaneous productions, and to those of Herdsmen.”

7. Manco Capac was the legendary founder of the Incan dynasty.

8. In the draft the next paragraph, enclosed in square brackets, reads: “Different animals require different foods. Why should not plants, which are not less different from each other in their organizations and characters: or are we to allow the food of different animals to be in

essence the same; all animals being fed by vegetables [*sic*] or by animals which are fed by vegetables?”

9. In the draft, following this sentence JM wrote: “Some of them affect the flavor and colour of particular plants.”

10. In the draft JM wrote here and crossed out: “Should this number of Elements, be reduced by future decompositions of some of them, into the other elements, a certain number of different elements must always remain.”

11. In the draft JM interlined here: “the putrefactions and dissolutions.”

12. This paragraph does not appear in the draft.

13. In the draft JM wrote here and crossed out: “In the case of certain insects which multiply with peculiar rapidity, and visit particular regions in such dense swarms, the destruction is almost instantaneous and altho.”

14. In June 1756 forces under the Nawab of Bengal, Siraj-ud-daula took the city of Calcutta. A number of Englishmen were confined to a barely ventilated fourteen-by-eighteen-foot room in Fort William on the night of 20 June resulting in the deaths of many. Legend has it that 146 people were confined in the Black Hole of Calcutta and that 123 of them died. It has subsequently been proved that there were from 39 to 69 imprisoned, with between 18 and 43 deaths (Mark Bence-Jones, *Clive of India* [London, 1974], 88–91).

15. In the draft JM added here: “and without any other resource of a purer air than in the exhaustible one covering the aqueous parts of the globe.”

16. In the draft this clause reads: “there would be not less than a thousand individuals, for every one now upon it.”

17. In the draft this sentence begins: “Increase their numbers five or ten fold.”

18. In the draft this clause reads: “can not be traced with certainty to its native district.”

19. The fragment of draft ends here.

20. Jethro Tull (ca. 1674–1741) was an English agricultural writer and inventor of the seed drill.

21. For Jean Baptiste van Helmont and his experiment, see “Notes on Agriculture,” ante–12 May 1818, and n. 6.

22. James Woodhouse (1770–1809) was born in Philadelphia and received his B.A. degree from the University of Pennsylvania in 1787, his M.A. in 1790. After receiving his medical degree under the supervision of Benjamin Rush, Woodhouse pursued his interest in chemistry

and assumed the chair in that subject at his alma mater in 1795. His work on nitrous oxide, starch, coal, and bread-making had practical implications and he was a pioneer in plant chemistry.

[23](#). JM referred here to John Taylor of Caroline's essay number 20 on manuring in *Arator; Being a Series of Agricultural Essays, Practical & Political: In Sixty-one Numbers* (2d ed., Georgetown, D.C., 1814; Shaw and Shoemaker 32909), 87–89.

[24](#). This story is from book 4 of Lucius Junius Moderatus Columella's *De Re Rustica (On Agriculture, 4.3*, trans. Harrison Boyd Ash, Loeb Classical Library [3 vols.; Cambridge, Mass., 1941], 1:363).

[25](#). Sir Humphry Davy's comments on gypsum as manure are found in his *Elements of Agricultural Chemistry* (Shaw and Shoemaker 34539), 296–99.

[26](#). Samuel Deane, *The New-England Farmer; or, Georgical Dictionary ...* (Worcester, Mass., 1790; Evans 22450), 105–6. Deane estimated that a woodlot of twenty acres or more would be necessary to supply firewood annually for a single fire.

Authorial notes

[The following note(s) appeared in the margins or otherwise outside the text flow in the original source, and have been moved here for purposes of the digital edition.]

[*](#) Dr. Robertson.

[*](#) Col. T. M. Randolph.

[*](#) Col. John Taylor.

[*](#) Columella.

[†](#) Sr. H. Davy.

Permalink <http://founders.archives.gov/documents/Madison/04-01-02-0244>
What's this?

Note: The annotations to this document, and any other modern editorial content, are copyright © The Rector and Visitors of the University of Virginia. All rights reserved.

SOURCE PROJECT Madison Papers
TITLE Address to the Agricultural Society of Albemarle, 12 May 1818

AUTHOR	Madison, James
DATE	12 May 1818
CITE AS	“Address to the Agricultural Society of Albemarle, 12 May 1818,” <i>Founders Online</i> , National Archives, last modified June 29, 2017, http://founders.archives.gov/documents/Madison/04-01-02-0244 . [Original source: <i>The Papers of James Madison</i> , Retirement Series, vol. 1, <i>4 March 1817–31 January 1820</i> , ed. David B. Mattern, J. C. A. Stagg, Mary Parke Johnson, and Anne Mandeville Colony. Charlottesville: University of Virginia Press, 2009, pp. 260–285.]

The National Historical Publications and Records Commission (NHPRC) is part of the National Archives. Through its grants program, the NHPRC supports a wide range of activities to preserve, publish, and encourage the use of documentary sources, relating to the history of the United States, and research and development projects to bring historical records to the public.